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Dynamics of N-fold Integration of Disparate Cognitive Modalities

Prefixes determining experience of the present moment underlying pseudophilia

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Introduction

Faced with multiple crises and conflicts of every kind, the world is witness to appeals for unity on the part of leaders variously embroiled in such crises. Despite the gravitas with which these appeals are framed, they can be increasingly recognized as naive -- in the light of past responses to such initiatives. (Finian Cunningham, *Biden's 'Unity'... By War? Information Clearing House*, 22 January 2021; Michael Rectenwald, *The 'democracy' and 'unity' of Biden's inaugural address have fine print: 'After dissent is silenced'*, *RT*, 20 January 2021).

The naivety with regard to simplistic understandings of unity is currently evident in the commentaries evoked (Peter Baker, *In Biden's Washington, Democrats and Republicans Are Not United on 'Unity'*, *The New York Times*, 21 January 2021; Julie Hollar, *Media Allow Republicans to Use 'Unity' as Tool of Division*, *FAIR*, 22 January 2021; Steve Chaggaris, *Joe Biden's difficult, if not impossible, push for 'unity'*, *Al Jazeera*. 21 January 2021; David Siders, *Biden gets a cold dose of 'unity'*, *Politico*, 21 January 2021; Joseph Stepansky, *Biden is promising 'unity'. But what does that mean? Al Jazeera*, 6 February 2021).

False optimism? Such appeals are consistent with one or more optimistic beliefs that are widely shared to a degree, variously including:

- the possibility of global peace as the outcome of insightful global leadership
- the discovery of some kind of philosopher's stone or Holy Grail -- a cognitive Rosetta stone by which differences could be reconciled
- a Theory of Everything as the outcome of scientific endeavour and insights of a higher order into transdisciplinarity (*Engaging with Insight of a Higher Order*, 2014)
- the possibility of a new Renaissance (*Missing the New Renaissance?* 2010)
- the arrival of a messianic leader, as variously prophesied
- anticipation of singularities of various kinds -- more especially a technological singularity (*Emerging Memetic Singularity in the Global Knowledge Society*, 2009)

These possibilities may well be articulated using "healing" as a metaphor, beyond any reference to healing individuals (David Corn, *Joe Biden's Inaugural Address Was a Plea for "Unity". But Healing the Nation's "Soul" Won't Be Easy. Mother Jones*, 20 January 2021; Edward Achorn, *Abraham Lincoln Healed a Divided Nation. We Should Heed His Words Today. Time*, 16 February 2020; Clinton Global Initiative, *Healing the Nation*, *Clinton Foundation*). Similar references could be found with respect to "healing the world'" and "healing the

Earth".

Unfortunately with regard to use of the healing metaphor, it fails to address the divisions between those who have contrasting understandings of "healing", whether inspired by a particular religion or by the challenge evident in healing the body (*Remedies to Global Crisis: "Allopathic" or "Homeopathic"?* 2009). The contrast between "mainstream" discourse and the protesting "dissenters" can be seen in this light.

Constraints: Complementing the hopes -- and the quest for their realization -- is an unfortunate array of constraints on integrative global sense-making. These might be understood to include:

- the evident inadequacy of the remedies variously proposed and implemented -- in the light of a depressing track record
- the evident disagreement about those remedies -- especially those promoted as alternatives
- the resource constraints associated with particular remedies -- and competition for possession of those resources
- the marked preference for simplicity in the face of undeniable complexity (and despite any technical need for detailed explanation) -- exemplified by preference for slogans, potentially embodied into marketing jingles
- the challenge of comprehension in a multilingual society -- despite assumptions regarding the use of international languages, especially English
- the challenge to interrelating the insights of the variety of disciplines claiming relevance -- especially in the light of the variety of jargons by which they affirm their distinctive expertise and identity
- the challenges to the credibility of those claiming unique knowledge of what is most appropriate -- given criticism of their relevance and track record from other perspectives, however questionable
- the restrictive claims on the articulation and implementation of remedies, especially with regard to use of technologies claimed to be relevant -- most obviously intellectual property rights (copyright, patenting, licensing, and the like) by which vital knowledge is incarcerated
- the emphasis on certification after a requisite period of learning for valid comprehension -- readily deemed elitist and of pseudo-relevance to the complex nature of emergent crises
- the emphasis on appropriate publication ("rendered public") as a guarantee of credibility -- in a period when such publication is dubiously and uncritically controlled by the few and potentially subject to levels of secrecy and paywalls limiting access and effective dissemination
- the relative indifference to the challenge to significant sectors of society in adapting to the imposition of new technologies -- most obviously the challenge for the elderly of online facilities (banking, welfare, voting), effectively institionalizing new forms of inequality, most obviously treating as irrelevant the time required for delivery and uptake
- marked delays in the diffusion of information and the uptake of significance -- despite claims regarding the role of the web
- the major shift from a degree of success in presentation of information in text to that presented visually or otherwise -- thereby raising questions as to what can be effectively communicated, to whom and with what delay
- a marked tendency to knee-jerk condemnation of the unconventional -- and the possibilities beyond convention and "outside the box"

Perspective? With respect to both the hopes for effective remedial responses and any critical analysis of the constraints, seemingly missing **is the lack of perspective on the various processes from which appropriately integrative understanding could emerge**

Complementing that lack of perspective is the lack of necessary appreciation of a "right to be ignorant" -- in contrast with the legal principle of *Ignorantia juris non excusat*. This could be understood as including:

- a right to be impatient at the inadequacies of elites claiming unquestionable competence
- a right to be unable (or unwilling) to understand complex explanations and proposals
- a right to act on a previously acquired knowledge base, however limited -- empowered as it may be by intuition (however misguided)
- a right to "rediscover the wheel" -- especially given its integrative symbolic role (as with the mandala)
- a right to assume that one has been "sold a pup" (*Having Bought into a Wreck -- What Now? Cognitive challenges of embodying reality otherwise*, 2018)
- the right to be dubious regarding elitist proposals such as the Great Reset
- the value of "unknowing" -- notably as celebrated with respect to creativity and mysticism

There is considerable irony to the fact that, however limited, a degree of perspective on such processes has been widely publicized through the "poem" notoriously presented by Donald Rumsfeld in his role as US Secretary of Defense in the midst of the so-called "humanitarian intervention" in Iraq. The focus on "known unknowns" and "unknown knowns" can be taken further with respect to "undoing" (*Unknown Undoing: challenge of incomprehensibility of systemic neglect*, 2008; *Strategic Patterns in terms of Knowing, Feeling and Action*, 2008).

Grasping for remedies? A fundamental problem with any quest for an integrative perspective in such a context is its recursive nature as a "grasping" exercise. It is a particular cognitive modality complementing a number of other cognitive modalities potentially valued more highly (by some) under certain circumstances. In this sense the quest itself has the potential of being as much a part of the problem as part of the solution. Failure to appreciate that inhibits recognition of what may be required to comprehend the nature of any viable solution. In seeking to grasp and possess the integrative remedy, the global significance and implications of a "solution" gets lost (*Beyond Harassment of Reality and Grasping Future Possibilities*, 1996)

The challenge, if it is to be framed metaphorically as such, is one of eliciting insight of a higher order (*Enhancing the Quality of Knowing through Integration of East-West metaphors*, 2000). If making sense and grasping are to be understood as features in an array of cognitive functions, it could then be asked how best to explore that possibility in the light of considerations such as the following:

- how many cognitive functions might be usefully distinguished? Of concern would be what might be recognized as "too few" (2?), and what might be recognized as "too many" (10?, 20?, 30?) -- by whom, when, and for what purpose?
- what resources point to constraints and possibilities in that respect (*Comprehension of Numbers Challenging Global Civilization*, 2014)
- if the closure implied by grasping is part of the problem, how could that too be called into question (Hilary Lawson, *Closure: A Short History of Everything*, 2002; Orrin E. Klapp, *Opening and Closing; strategies and information adaptation in society*, 1978; *Openness and Closure in Pattern Language: geometry versus resonance*, 2012)
- how best to engage with cognitive functions (too) readily labelled when the significance of the labels tends to shift depending on the number of functions recognized
- the insight of Albert Einstein: *Problems cannot be solved by the same level of thinking that created them.*

Questionable answers? Framing the challenge through the use of questions, as above, to which the possibility of answers is implied, may itself be problematic -- however indicative. How does the binary dynamic of question and answer fit into any dynamic array of cognitive functions?

It would seem that some such possibility is being explored otherwise as "joined-up thinking" (Rick Lewis, *Joined-up Thinking*, *Philosophy Now*, Nov/Dec 2014; Chris Frith, *Neuroscience: Joined-up thinking*, *Nature*, 2014; Philip Delves Broughton, *Joined-up thinking*, *Financial Times*, 8 June 2011; *Joined-up Thinking*, *Lloyd's News*, 1 December 2014; *EU development policy needs joined-up thinking, say MEPs*, *European Parliament News*, 25 October 2012).

Is the dynamic between joined-up thinking and the prevalence of silo mentalities to be recognized as exemplifying a problematic binary framing?

How is this form of integrative thinking enabled within the world wide web? (*Corpus Callosum of the Global Brain? Locating the integrative function within the world wide web*, 2014). Rather than "materialism", is global civilization in process of being systematically confused by pseudophilia?

In quest of a "cognitive gearbox" or transmission system

One framing of this exploration is discussed separately as *Shifting between strategic patterns: transmission systems and gearing* (*Global Coherence by Interrelating Disparate Strategic Patterns Dynamically: topological interweaving of 4-fold, 8-fold, 12-fold, 16-fold and 20-fold in 3D*, 2019).

Of interest with respect to the gear metaphor, a bicycle may have 16 to 18 usable gear ratios. A truck may have 10 or more gears (*9, 10, 13, 15 and 18 Gears - Shifting Theory | Drive Truck*, *Smart Drive*; *How to Shift an 18 Speed Transmission like a Pro*, *Smart-Trucking*, 7 December 2018; *How to use an 18-Speed Roadranger*, *TruckSales*, 16 August 2018). Is the current global strategic challenge to be compared to this description of driving a 15-speed truck:
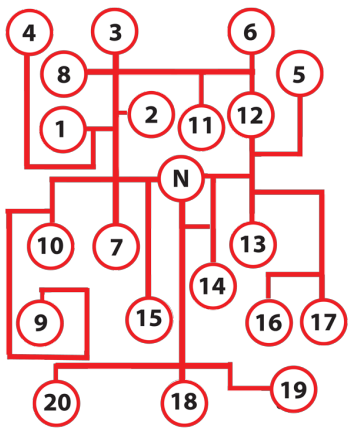
> Now I'll just touch on what a 15-speed is for a moment. If you get in a truck and it's got a blue button in it, it's a 15-speed. Now this is not a splitter in a 15-speed transmission. This is what is called deep reduction. And the best way to explain deep reduction on a 15-speed is that essentially you've got three tiers of five gears. Five gears way down in the basement, five gears on the main level, and five gears upstairs. Most of the time you're going to drive a 15-speed like a ten-speed. 1,2,3,4,5, flip up the range selector, back over to low - and for those of us who drive 13s and 18s and then get into 15- that's very weird for us to go back to low - but back to low 1,2,3,4,5 shift it like a ten-speed.
>
> Now if you get into a gravel pit or something like that you need deep reduction, the best way to understand deep reduction in a 15-speed is like four-wheel drive low and four-wheel-drive hi. That's the difference. And it's not sequential, so if you're in deep reduction in 15-speed you can't go one, two, three, four, five and then split up to the next gear and go the other five. It's more like up to five in the low low and then up to three on the next level. So it's a little bit strange, but if you ever get into a 15-speed, just kind of play around with it and you'll get use to it. But know that if the splitter is blue it's a 15-speed; if it's red, it's 13; and if it's grey, it's 18. And in this day and age of non-synchronous transmissions, most of them are going to be 18-speeds. (*9, 10, 13, 15 and 18 Gears - Shifting Theory*)

Automobiles have a variety of relatively simple gear shift patterns with which many are familiar. Whilst there is considerable familiarity with shifting between many gears in vehicles of different types, this familiarity would appear to be totally lacking in the case of strategic patterns. It could be imagined that truck drivers have mnemonic aids with respect to learning the complex gear shift patterns, as shown below-centre. Curiously, however, there are many references to the "*Truck Driver's Gear Change*" as descriptive of modulation in music -- but not as a mnemonic device.

What appears to be required is some recognition of the value of the set of contrasting "strategic gears" **as a whole** (8-fold, 12-fold, 15-fold). The metaphor is also suggestive with respect to the relation **between** the strategies in any set -- as is so evident in driving a 15-gear truck. Driving in one gear only would be considered ridiculous. The question would then be what are the analogues to enable shifting **between strategic patterns** according to circumstances -- or to shifting between strategies **within any one such pattern** (as suggested below right). Or between cognitive modalities?

Mnemonic aids to a set of contrasting strategic patterns?		
As suggested by a well-known song?	As suggested by a gear shift pattern in trucks	Single pattern: UN SDGs as "strategic gears" ?
On the 12th day of Christmas my true love sent to me:		1. No Poverty 2. Zero Hunger

12 drummers drumming
11 pipers piping
10 lords a-leaping
Nine ladies dancing
Eight maids a-milking
Seven swans a-swimming
Six geese a-laying
Five golden rings
Four calling birds
Three french hens
Two turtle doves, and
A partridge in a pear tree

3. Good Health and Well-being
4. Quality Education
5. Gender Equality
6. Clean Water and Sanitation
7. Affordable and Clean Energy
8. Decent Work and Economic Growth
9. Industry, Innovation, and Infrastructure
10. Reducing Inequality
11. Sustainable Cities and Communities
12. Responsible Consumption and Production
13. Climate Action
14. Life Below Water
15. Life On Land
16. Peace, Justice, and Strong Institutions
17. Partnerships for the Goals

Clues from prefixes to "re-cognition" of functional predetermination of cognitive modalities

Prefixes: There is an intriguing possibility that the array of cognitive functions in which people engage is indicated in some manner by the array of prefixes. In that sense cognitive modalities are predetermined -- "pre-fixed" -- by use of such prefixes in reflection and discourse. This possibility has been variously explored in previous studies, notably highlighting the ambiguity associated with the role of the prefix "con":

- *New Paradigms via a Renewed Set of Prefixes: dependence of international policy-making on an array of operational terms*, (2003).
- *Exploration of Prefixes of Global Discourse: implications for sustainable confidelity* (2011)
- *Prefix "Re-cognition" as Prelude to Fixing Sustainability -- "Pro" vs "Con" ? Speculative review of missing emphases potentially vital for psychosocial balance* (2017)
- *Primary Global Reserve Currency: the Con? Cognitive implications of a prefix for sustainable confidelity* (2011)
- *Considerable Conglomeration of "Cons" of Global Concern: eightfold constraint on constructive conflict control?* (2010)

Ambiguities and problematic bias: Of particular relevance to any such exploration are the challenging ambiguities of language, interpretation and comprehension of significance -- irrespective of detailed authoritative definitions. Those later explorations were preceded by a particular focus on the possibility that the prefix "non-" in "non-governmental" might be translated and comprehended as "anti-governmental" in some languages (*Conceptual Distortions from Negative Descriptors*, 1974). A related exercise explored the question of whether structural distinctions of importance to any understanding of unity, such as "inter-", "multi-" and the like, were distorted in translation (*Conceptual Gaps and Confused Distinctions: possible ambiguities in the translation of interrelated concepts between sectors, jargons or languages*, 1974).

It is noteworthy that a prefix ending in a consonant may have that consonant assimilated into the next consonant in a compound -- notably in the case of ob-. Some prefixes ending in a vowel may have a consonant added, if the word-root starts with a vowel.

Of potential relevance with regard to prefixes and any ambiguity is the role of homonyms, homographs, and homophones as usefully framed diagrammatically by William S. Huff (*Homonym, Homonym and Homonym, and Other Word Pairs*, *Symmetry: Culture and Science*, 3, 1992, 1) -- and discussed further below..

The following exercise is focused on English usage, ignoring **how ambiguities might be more fruitfully taken into account** in the light of some of the constraints noted above. Reference is however made below to the Chinese *Bagua* encoding used in the configuration by Huff.

Conflation of significance: Given the highly polarised dynamics of discourse -- locally, nationally and globally -- at one extreme it is appropriate to note how all cognitive modalities may be reduced to a single binary pair. This is epitomised by "us" and "them" modalities -- "for" or "against", or "pro" or "con". An intermediary condition could be recognized in which cognitive modalities are articulated into a 12-fold pattern, namely as a set of 12 prefixes, as discussed separately (*Eliciting a 12-fold Pattern of Generic Operational Insights: recognition of memory constraints on collective strategic comprehension*, 2011)..

Given the tendency to reduce any such articulation to a single binary pair, it is to be expected that the 12-fold pattern would highlight 6 binary pairs as intermediary stages in collapsing such an array of distinctions, as discussed separately in the light of a tendency to misplaced concreteness with respect to what is held to be factual (*Ordering patterns of articulation?* 2020)

Despite the "con-troversy" and "pro-test" which such a possibility would tend to evoke -- including its "re-jection" -- there is the further possibility that any 12-fold pattern would evoke "re-cognition" of 4 3-fold patterns and 3 4-fold patterns within that 12-fold pattern. There is of course the tendency to "con-test" the very existence of a 12-fold pattern in some form, despite widespread enthusiasm for its existence (*Checklist of 12-fold Principles, Plans, Symbols and Concepts: web resources*, 2011).

The confusion which reigns in discourse at every level of society suggests that **"re-cognition" of distinct cognitive modalities tends to be variously conflated according to preferences which remain to be fully understood**. Most obvious are the relatively inexplicable preferences for 8-fold and other N-fold patterns, as discussed separately (*Patterns of N-foldness: comparison of integrated multi-set concept schemes as forms of presentation*, 1980).

"Calculus of indications"? In taking the exploration further, it should again be emphasized that **what is seemingly required is to incorporate or "re-cognize" degrees of "con-flation" and "con-fusion" rather than presuming to achieve "con-sensus" on definitional closure on any pattern of articulation**. Rather than being subject to conventional definition, the process of refinement through abstraction and generalization suggests that the result is best understood in terms of memeplexes -- somewhat analogous to the compactification of higher dimensionality which is a feature of fundamental physics (Omar Zatarain and Yingxu Wang, *Formal Concept Refinement by Deep Cognitive Machine Learning. 16th IEEE International Conference on Cognitive Informatics and Cognitive Computing*, July 2017).

In this sense the cognitive implication of memeplexes can be better indicated by systems of notation rather than distorting the connotations through conventional terms. Understood otherwise -- namely experientially -- the various references to a "calculus of indications" offer one possibility:
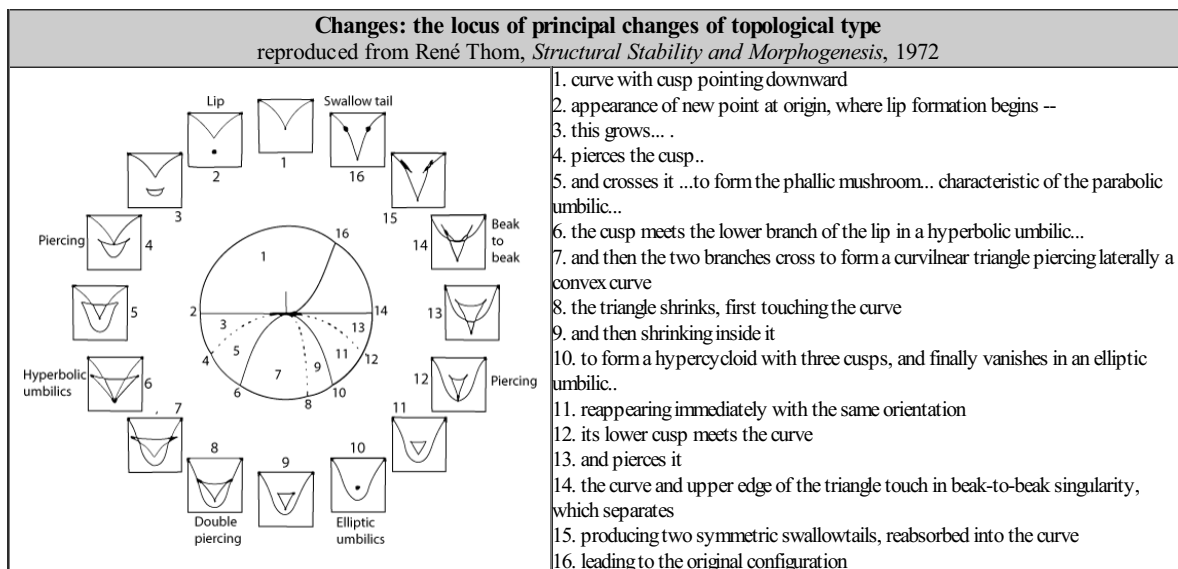
- George Spencer Brown: Laws of Form (1969): Patricia Ene, *Descriptions as Distinctions: George Spencer Brown's Calculus of Indications as a Basis for Mitterer's Non-dualistic Descriptions* (*Constructivist Foundations*, 8, 2013, 2)
- Francisco J. Varela: *The Extended Calculus of Indications Interpreted as a Three-valued Logic* (*Notre Dame Journal of Formal Logic*, 20, 1979, 1); *A Calculus for Self-Reference*, International Journal of General Systems, 2, 1975, 1)

The patterns of hexagrams and tetragrams of various Chinese classics offer another possibility, especially given the metaphors associated with the comprehension of their significance.

Catastrophe theory? One approach to the relevant cognitive dynamics is the innovative exploration of topology and catastrophe theory by Rene Thom (*Structural Stability and Morphogenesis: an outline of a general theory of models*, 1972), further developed by Christopher Zeeman (*Catastrophe theory. Selected papers, 1972-1977*, 1977), offered a formalization of the intuitive insights of authors from a variety of disciplines (David Aubin, *Forms of Explanations in the Catastrophe Theory of Rene Thom: topology, morphogenesis, and structuralism*, 2004). Can a prefix be understood as implying a form of cognitive catastrophe -- as with a question?

It is therefore a "provocative" challenge to read the "generalization" characteristic of the argument of Thom's original study as including -- or "implying" -- the structural stability and morphogenesis of intercourse in both its physical and non-physical forms (*Human Intercourse: Intercourse with Nature and Intercourse with the Other*, 2007). Can catastrophe theory, and the associated bifurcation theory, be read as "intercourse theory" -- effectively making them a topological "*Kama Sutra* of intercourse"?

From this perspective it is interesting to recognize the "suggestive" nature of the following sequence of 16 images -- possibly to be understood as "visual primitives" characteristic of the attraction dynamics of intercourse, in its specific and general senses as discussed separately (*Reframing the Dynamics of Engaging with Otherness*, 2011).

Changes: the locus of principal changes of topological type
reproduced from René Thom, *Structural Stability and Morphogenesis*, 1972

1. curve with cusp pointing downward
2. appearance of new point at origin, where lip formation begins --
3. this grows... .
4. pierces the cusp..
5. and crosses it ...to form the phallic mushroom... characteristic of the parabolic umbilic...
6. the cusp meets the lower branch of the lip in a hyperbolic umbilic...
7. and then the two branches cross to form a curvilnear triangle piercing laterally a convex curve
8. the triangle shrinks, first touching the curve
9. and then shrinking inside it
10. to form a hypercycloid with three cusps, and finally vanishes in an elliptic umbilic..
11. reappearing immediately with the same orientation
12. its lower cusp meets the curve
13. and pierces it
14. the curve and upper edge of the triangle touch in beak-to-beak singularity, which separates
15. producing two symmetric swallowtails, reabsorbed into the curve
16. leading to the original configuration

Fundamental binary dynamic associated with objectivity versus subjectivity?

Relating forms of "objectivity" and "subjectivity" through exploratory mappings: The previous exercises (noted above) focused on cognitive modalities associated with the prefixes "pro-" and "con-" as a fundamental binary. Arguably that binary can be understood as related to "ob-" and "sub-" as only too evident in the dynamics of the con-troversy associated with objectivity and subjectivity.
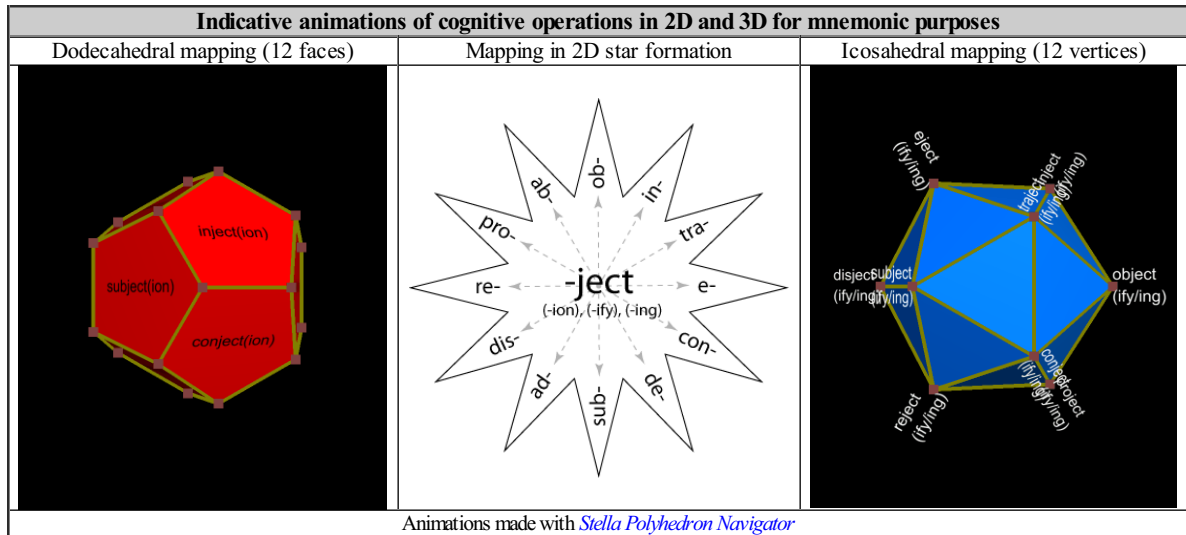
The table below is an exercise in interrelating words ending in "-ject", whether or not they may have accepted suffixes -- given the sets of prefixes that may be associated with "-ject". A distinction is suggested by noun (N) and verb (V) forms -- and possibly adjectival (A) forms.

It is assumed that "-ject", with its etymological origins in the Latin *jacere* (to throw), is indicative of a fundamental cognitive engagement with externality in contrast with internality -- across the boundary defining a system in relation to any sense of otherness. Metaphorically it

is perhaps usefully compared with a cognitive "Big Bang", typical of creativity, and resulting in the reification of objects. These may either be incorporated as an articulation of the system or (r)ejected as inappropriate to its coherence -- then variously "remaindered" or "left behind". The processes include imbuing objects with significance (as with the pattern of pieces on a chess board) and "world-making", or the practice of "throwing" clay in pottery (with its metaphorical connotations).

| Tentative organization of forms of "-ject" into polar extremes (irrespective of whether terms and grammatical variants are in common usage)				
Polarity		Extreme A		Extreme B
	suffixes: ion / ify / ing / ive	N: Dodecahedral mapping? V: Icosahedral mapping?	suffixes: ion / ify / ing / ive	N: Dodecahedral mapping? V: Icosahedral mapping?
Engagement?	Object	N: treatment of X as an object presented to the senses	Subject	N: subordination of X; X as a subject of study
		A: objective		A: subjective
		V: objecting to X (as a form of protest)		V: subjecting X to constraints; to subjugate X
Reformation?	Project	N: an envisaged undertaking	Conject	N: conjecture; a conception
		V: envisaging an undertaking; transfer of meaning onto X; extrapolating		V: to conceive or imagine; to envisage a possibility
Gatekeeping?	Eject	N: ejection of non-believers; "left-behind"	Reject	N: rejection of opponents; a reject; remaindered; denial
		V: to eject X from within the system		V: to reject X as externally encountered; to deny
Development?	Inject (interject)	N: injection of X; inoculation; indoctrination	Adject	N: addition of X
		V: to inject X into a whole		V: to add X to a whole
Relational?	Disject	N: dispersal; distribution	Traject	N: transmission; conveyance
		V: to disseminate X		V: to transmit; to convey; to channel; to supply
Qualitative effect?	Abject	N: degradation; outcast; worthless	Deject	N: dejection; desperation
		V: to render abject; to dishonour; to devalue		V: to dishearten; to dispirit; to discourage

Polyhedral mapping: The assumption is made that the **noun forms** lend themselves more appropriately to presentation on the **faces** of a polyhedron -- hence the use of the dodecahedron below. Such faces are especially consistent with a sense of an extended "field" of experience. By contrast the **verb forms**, with the dynamics of the activity they suggest, lend themselves more appropriately to presentation on the **vertices** of a polyhedron -- hence the use of an icosahedron below. The tentative indication of polar extremes is held by opposite faces in the case of the dodecahedron, and by opposite vertices in the case of the icosahedron.

Indicative animations of cognitive operations in 2D and 3D for mnemonic purposes		
Dodecahedral mapping (12 faces)	Mapping in 2D star formation	Icosahedral mapping (12 vertices)

Animations made with *Stella Polyhedron Navigator*

Further understanding is suggested by unfolding the dodecahedron (below left), into a "flat" array of distinct domains -- thereby depriving the set of the integrative coherence of their configuration around a centre. Such a centre -- as the instigating locus of any creative "Big Bang" -- is clearly equivalent to that of the icosahedral form with its emphasis on the dynamics along the axes through it between polar extremes.

The relation between the two polyhedral mappings can be suggested by an animation morphing between the geometric duals (below right). This is suggestive of the underlying cognitive "conflation" of the variants distinguished grammatically through the suffixes.

Eliciting further insight from geometrical transformation of polyhedral mappings	
Unfolding of dodecahedral mapping	Morphing between dodecahedral and icosahedral forms

Animations made with *Stella Polyhedron Navigator*
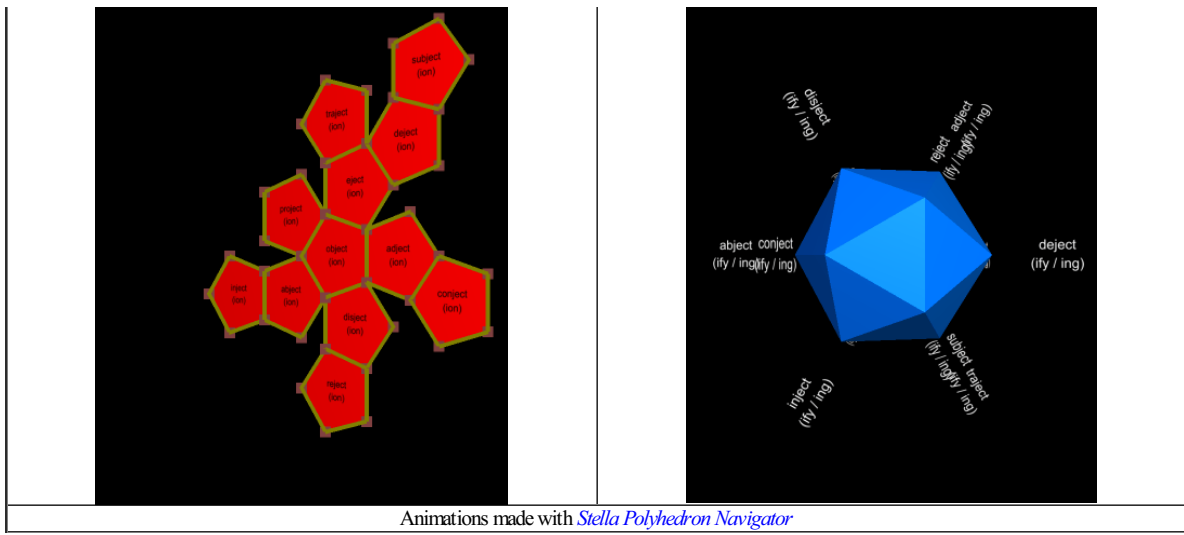
Exploring the functional interplay of prefixes and word-roots

This argument has focused on the predetermination of distinct cognitive dynamics by a prefix with the implication that the array of prefixes then constitute a systemic array of some kind -- or can be reduced to one. Clearly the argument can be developed through recognition of an array of root words with which those prefixes may associated. Again the question arises as to whether a limited set of such root words constitutes the articulation of a system of some kind. There is then the obvious possibility that the significance associated with such root words tends to be variously con-flated and con-fused in practice -- possibly reduced to a binary dynamic.

The argument here is that there is a relatively limited array of prefixes and of root words which could be usefully understood as framing coherent cognitive engagement with otherness. **Clearly the array in each case can vary in size, with elements in a larger array susceptible to being collapsed together to form an array of smaller size**. Arguably all such elements could be collapsed into a binary array, for example -- or developed from one

Of interest is then the range of cognitive functions to which such elements might then correspond -- whether as prefixes or as word-roots. Again how many functions might be appropriately recognized (or subsumed) in each case? How are the two sets of functions -- as indicated by prefixes or by word-roots -- to be distinguished?

The following table helps to clarify that possibility, as discussed separately (*Exploration of Prefixes of Global Discourse: implications for sustainable confidelity*, 2011). This is suggestive of the nature of the challenge but the systemic implications are perhaps better explored in the simpler variant below. In this case interpreting the selected column headings metaphorically indicates the manner in which this affects interpretation of the application of the prefixes (in the rows) to them. A metaphorical emphasis suggests a manner in which synonyms (indicative of related functions) might be associated either in column or row headings.

Clearly commonly recognized words may not be apparent in the cells of certain column-row combinations -- potentially evoking the question as to why that is the case -- or pointing to the existence of synonyms (or homonyms) more commonly recognized.

Selected prefixes and their usage in relation to word-roots (tentative) (adapted from *New Paradigms via a Renewed Set of Prefixes*, 2003 and *Selected prefixes and their usage in relation to word-roots*, 2011)														
Roots	*Metaphor*	**Prefixes**												
.	.	Ob-	Sub-	Co-	Pro-	Ex- / E-	Re-	In-	Ad-	Dis-	Tra-	De-	A-
.	.			Com- / Con-	Pre-	Extro-	Retro-	Im-/ Into-		Di-	Tran-	.	Ab-
.	.			*Together / With*	*Before For / Forward*	*Out of Beyond*	*Repetition*	*Into On*		*Separation Apart*		*Down From / Away*	*Away from*
-ject(ion)	*Throw*	Object	Subject	Conject(ure)	Project	Eject	Reject	Inject		.Disject		Deject	Abject
-stitute	*Placement*		Substitute	Constitute	Prostitute		Restitute	Institute				Destitute	
-sent(ment)	*Agreement*			Consent	Present(ation) / Present(i)ment	.	Resent	.		Dissent		.	Assent
-script -scribe	*Attribute*		Subscirbe	Conscript	Prescription / Proscription	.	Rescript	Inscription		.		Description	Ascription
-sign	*Attribute*			Consign	Presign	.	Resign	Insignia?		.		Design	Assign
-voke	*Attribute*			Convoke	Provoke	Evoke	Revoke	Invoke		.		.	Avocation
-act(ive)	*Change*			Coaction	Proactive	Exact	Reactive	Inactive		Disactive?		Deactivate	.
-duce	*Change*			Conducive	Produce	Educe	Reduce	Induce	Adduce	.		Deduce	Abduction
-gress(ion)	*Change*			Congress	Progress	Egress	Regress	Ingress		Digress		Degress	Aggress
-miss(ion)	*Change*		Submission	Commission	Promise?	Emission	Remission	Intromission	Admission	Dismiss		Demission	.
-spire	*Change*			Conspire	Perspire?	Expire	Respire / Despite?	Inspire		.	Transpire	.	Aspire
-sume	*Change*		Subsume	Consume	Presume	Exhume?	Resume	.		.		.	Assume
-cede	*Cut*			Concede	Procedure / Precede(nce)	Exceed?	Recede	Intercede		.		.	Accede
-cession	*Cut*			Concession	Procession / Precession	.	Recession	.		.		.	Accession
-cision	*Cut*			Concision	Precision	Excision	Rescind?	Incision		.		Decision	Abcision
-tract	*Engage*		Subtract	Contract	Protract	Extract	Retract	Intractable		Distract		Detract	Attract
-press(ion)	*Hold*			Compress	Prepress	Express Egress	Repress	Impress Ingress		.		Depress	.

|													
-serve	*Hold*		Subserve	Conserve			Reserve			Disserve		Deserve	.
-tain	*Hold*	Obtain		Contain			Retain			Disdain?		Detain	Attain
-vent(ion)	*Initiate*		Subvention	Convention	Prevent	Event	Re(in)vent	Invent					
-cord	*Match*			Concord			Record			Discord			Accord
-fer(ence)	*Match*			Confer(ence)	Proffer / Prefer(ence)		Refer(ence)	Infer(ence)		Differ		Defer(ence)	.
-verse	*Mirror*		Subverse	Converse / Covert / Conversion	Proverse	Extrovert	Reverse	Inverse / Introvert	Adverse	Diverse			
-volution	*Mirror*			Convolution	.	Evolution	Revolution	Involution				Devolution	.
-motion	*Move*			Commotion	Promotion	Emote	Remote					Demote	.
-port	*Move*			Comport	Proportion	Export	Report	Import		Disport	Transport	Deport	.
-position	*Position*			Composition	Proposition	Exposition	Reposition	Imposition		Disposition	Transpostion	Deposition	.
-sist(ance)	*Position*		Subsistence	Consist	.	Exist?	Resist	Insist				Desist	Assist
-join	*Relate*			Conjoin	.		Rejoin			Disjoin			.
-late	*Relate*			Collate	Prolate/Prelate	.	Relate			Dilate	Translate		.
-pend	*Relate*			Co(de)pend	Propend/Prepend	Expend	.	Impending				Depend	Append
-tend	*Relate*		Subtend	Contend	Pretend/Protend	Extend	.	Intend		Distend			Attend
-tent(ion)	*Relate*			Contention	Pretention	Extention	Retention	Intention		Distention		Detention	Attention
-fect	*Shape*			Confection	Prefect	Effect	Refect(ory)	Infection				Defect	Affect
-fine	*Shape*			Confine	.		Refine					Define	Affine
-flate	*Shape*			Conflate			Reflate?	Inflate		Dis(af)fection		Deflate	
-form(ation)	*Shape*			Conform	Preform / Proforma?		Reform(ation)	Inform(ation)		Disformity?	Transformation	Deform(ation)	.
-struct	*Shape*			Construct			Restructure	Instruct				Destruct	
-prove	*Verify*						Reprove	Improve		Disprove			Approve
-sure	*Verify*			Pressure			Re(assure)	Insure					Assure
-test	*Verify*			Contest	Protest/Pretest		Retest	Intestate?				Detest	Attest
-validate	*Verify*			Covalididate	.		Revalidate	Invalidate				Devalidate	
-ception	*View*			Concept	Precept	Exception	Reception	Inception				Deception	.
-spect	*View*				Prospect	Expect ?	Respect	Inspect					Aspect
-vise / -vision	*View*			.	Provision/Prevision	.	Revision			Division		Devise	.
-gestion				Congestion				Ingestion		Digestion			

Polyhedral clues to comprehension of N-fold systems of cognitive functions

There is every reason to recognize the "fluidity" with which cognitive functions are experienced, defined and clustered under different circumstances -- further complicated by issues of background, education and culture (and especially language).

As noted above, there is a case for clarifying a form of "cognitive gearbox" if only metaphorically -- namely a transmission system through which people shift between simpler and more complex articulations. The possible range of gears may not be accessible or desired by all -- as suggested above by the contrast between 20-fold gear shifts in heavy duty trucks and that of simple automobiles and bicycles.

The argument can notably be developed with respect to values -- so widely evoked as underpinning global civilization (*In Quest of a Strategic Pattern Language: a new architecture of values*, 2008).

Arrays of cognitive functions: The variety is suggested by the examples of the earlier study noted above (*Patterns of N-foldness: comparison of integrated multi-set concept schemes as forms of presentation*, 1980). The contrasting combinations of prefixes and word-roots are suggested visually by the arrays in the following. Here it understood that either the functional significance of the prefixes, or of the word-roots is collapsed (conflated) -- or developed. In the image bottom left, for example, this would imply that the significance carried by prefixes is reduced to a fundamental binary (positive-negative; yin-yang) and applied to a fundamental set of 12 word-roots.

Contrasting arrays of prefixes (P) and word-roots (R) (indicative)

P=12, R=6
P=6, R=6
P=4, R=12
P=12, R=2
P=2, R=12
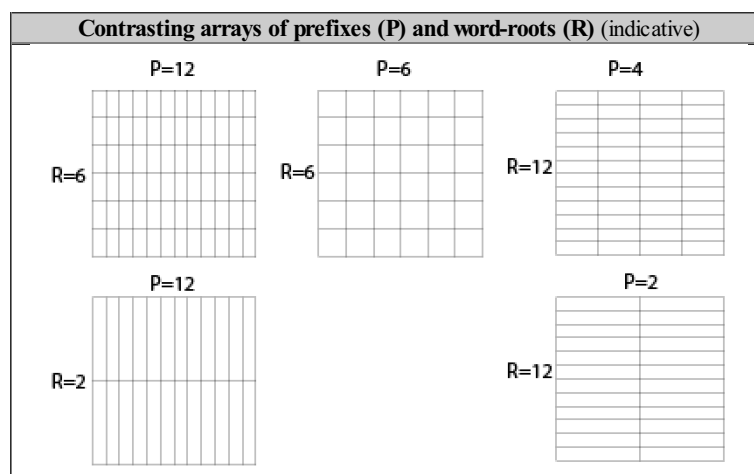
Despite conventional definitions, how functional significance is cognitively "refined" by abstraction and generalization into a binary pair (*yin-yang*) is of course a fundamental philosophical challenge -- far too readily framed simplistically in terms of labels such as positive-negative or good-evil.

"Cognitive functions"? Usefully summarized in some detail by *Wikipedia*, the literature on psychological functions (or "cognitive functions") derives from the work of Carl Jung. This distinguished an 8-fold array of functions based on extroverted and introverted forms of thinking, feeling, sensation and intuition. More complex variants, presented as tabular arrays, have been formulated by Isabel Myers (resulting in the *Myers-Briggs Type Indicator*), John Beebe, Linda Berens, and Lenore Thomson.

The emphasis in each case tends to be on classification of personality types rather than on how the distinctive functions might be employed and interrelated (if not strategically "managed") by an individual. Especially noteworthy is the unfortunate dynamic in practice between those favouring one or other array -- raising questions of independence, bias, and conflict of interest.

A number of related theories complicate the emergence of any coherent systemic understanding: 16 Personality Factors, Big Five personality traits, Enneagram of Personality, Five temperaments, and Four temperaments.

Polyhedra as cognitive systems: In the quest for a method of reframing the challenge of comprehension of cognitive systems of different complexity, one useful possibility is the use of symmetrical polyhedra -- of which examples are given above. Such use follows from the extensive study by Buckminster Fuller (in collaboration with E.J. Applewhite) of an understanding of synergetics (*Synergetics*: *Explorations in the Geometry of Thinking*, 1975; and *Synergetics 2: Explorations in the Geometry of Thinking*, 1979).

However little explicit reference is made there to the cognitive implications, as argued separately (*Geometry of Thinking for Sustainable Global Governance: cognitive implication of synergetics*, 2009). As indicated there with respect to systems as polyhedra, such references as there are include:
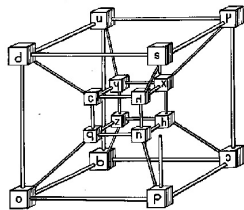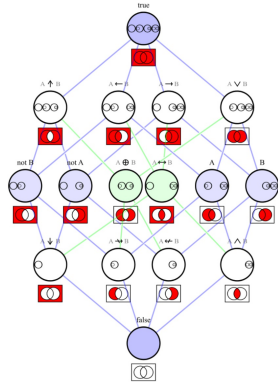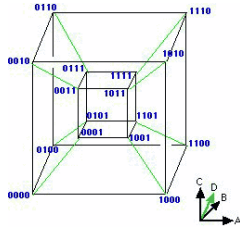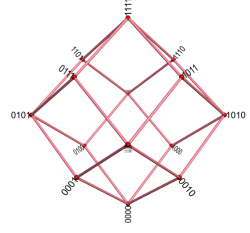
- *Synergetics is the geometry of thinking. How we think is epistemology, and epistemology is modelable; which is to say that knowledge organizes itself geometrically...* (I, 905.01)
- *Any conceptual thought is a system and is structured tetrahedrally. This is because all conceptuality is polyhedral. (I, 501.101). By tetrahedron, we mean the minimum thinkable set that would subdivide Universe and have inter- connectedness where it comes back upon itself.* (I, 620.03)
- *All systems are polyhedra: All polyhedra are systems.* (II, 400.56)
- *Human thoughts are always conceptually and definitively confined to system considerablility and comprehension....All systems are subject to comprehension* (I, 400.07-20)

Associating prefixes and word-roots with polyhedra: There is therefore a case for exploring further how prefixes and word-roots -- of functional significance in systemic terms -- could be associated with polyhedral forms.

- **Oppositional logic**: This is potentially consistent with the exploration by logicians of patterns of Boolean logical connectives in oppositional geometry (*Oppositional Logic as Comprehensible Key to Sustainable Democracy: configuring patterns of anti-otherness*, 2018; *Neglected recognition of logical patterns -- especially of opposition*, 2017; Fabien Schang, *An arithmetization of logical oppositions*).

  Of particular relevance is the application explored by Fabien Schang (*International Disagreements*, University of Tartu, 2014; *An arithmetization of logical oppositions*). The pattern of connectives is however limited to the 16 of fundamental importance to computer search operations (AND. OR, NOR, XAND, etc) although their configuration in 3D reduces them to 14 -- or calls upon a 4D form, as indicated below

  However, despite their obvious importance as parts of speech of a particular form, such **"logical connectives" are quite distinct from the predetermining cognitive role of prefixes** -- especially given the various dynamic roles which the latter may imply. **As "pre-fixes" they tend to imply a degree of "re-cognition" absent from connective logic**, whether or not there is a degree of systemic correspondence.

| Arrays of logical connectives			
The Logic Alphabet Tesseract - a four-dimensional cube (see coding). by Shea Zellweger	Hasse diagram of 16 logical connectives	Topologically faithful 4-statement Venn diagram is the graph of edges of a 4-dimensional cube as described by Tony Phillips	Organization of contingent bitstrings on a rhombic dodecahedron
Diagram by Warren Tschantz (reproduced from the Institute of Figuring) .	Watchduck (a.k.a. Tilman Piesk), Public domain, via Wikimedia Commons	A vertex is labeled by its coordinates (0 or 1) in the A, B, C and D directions; the 4-cube is drawn as projected into 3-space; **edges going off in the 4th dimension are shown in green.**	Adapted from Lorenz Demey and Hans Smessaert (2017)

- **Algebraic topology**: As noted in a review of recent research, nobody understands the brain's wiring diagram, but the tools of

algebraic topology are beginning to tease it apart. (*How the Mathematics of Algebraic Topology Is Revolutionizing Brain Science MIT Technology Review*, 24 August 2016)

In pursuing their art, algebraic topologists set themselves the challenging goal of finding symmetries in topological spaces at different scales.
And the neural networks that AI systems depend on draw their inspiration from the structure of brain. Now that new structures are emerging through this kind of analysis, how will the AI community incorporate these discoveries and exploit algebraic topology is their work?

As shown below, by tracking clique patterns through a network filtration reveals key structures become apparent (Ann Sizemore, et al, *Cliques and Cavities in the Human Connectome arxiv.org*, 20 December 2016)

Topological cavities in the structural brain network

Reproduced from Ann Sizemore, et al (2016)
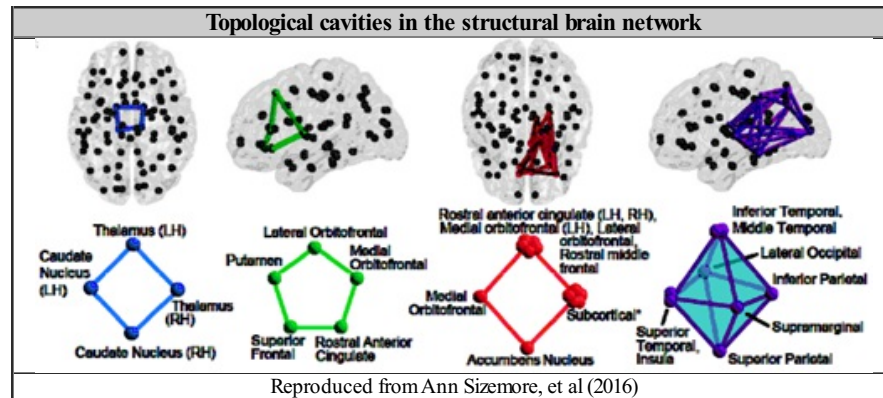
- **Neuroscience**: The arguments above merit comparison with the results of recent neuroscience research indicating the remarkable possibility of cognitive processes of up to 11-dimensional form in the light of emergent neuronal connectivity in the human brain, discussed separately (*Brain organization, cognition, comprehension -- and music*, 2019). As summarized there:

  Using mathematics in a novel way in neuroscience, the Blue Brain Project shows that the brain operates on many dimensions, not just the three dimensions that we are accustomed to. For most people, it is a stretch of the imagination to understand the world in four dimensions but a new study has discovered structures in the brain with up to eleven dimensions - ground-breaking work that is beginning to reveal the brain's deepest architectural secrets..... these structures arise when a group of neurons forms a clique: each neuron connects to every other neuron in the group in a very specific way that generates a precise geometric object. The more neurons there are in a clique, the higher the dimension of the geometric object. ...

  The appearance of high-dimensional cavities when the brain is processing information means that the neurons in the network react to stimuli in an extremely organized manner. It is as if the brain reacts to a stimulus by building then razing a tower of multi-dimensional blocks, starting with rods (1D), then planks (2D), then cubes (3D), and then more complex geometries with 4D, 5D, etc. The progression of activity through the brain resembles a multi-dimensional sandcastle that materializes out of the sand and then disintegrates. (*Blue Brain Team Discovers a Multi-Dimensional Universe in Brain Networks*, *Frontiers Communications in Neuroscience* 12 June 2017)

- **AI language models:** As summarized by Will Douglas Heaven (*AIs that read sentences are now catching coronavirus mutationsword and sentences*, *MIT Technology Review*, 14 January 2021). This refers to a study by Brian Hi, et al, (*Learning the langu.ge of viral evolution and escape*, *Science*, 371, 2021, 6526) which concludes, with illustrations, that:
  - Modeling viral escape requires characterizing semantic change and grammaticality.
  - Semantic embedding landscape is antigenically meaningful.
  - Biological interpretation of language model semantics and grammaticality enables escape prediction.

  The key insight making this possible is that many properties of biological systems can be interpreted in terms of words and sentences. A handful of researchers in the last few years—including teams from geneticist George Church's lab and Salesforce—have shown that protein sequences and genetic codes can be modeled using NLP techniques.

  In the new study, Bonnie Berger, a computational biologist at the MIT, and her colleagues pull several of these strands together and use NLP to predict mutations that allow viruses to avoid being detected by antibodies in the human immune system, a process known as viral immune escape. The basic idea is that the interpretation of a virus by an immune system is analogous to the interpretation of a sentence by a human.

  Berger's team uses two different linguistic concepts: grammar and semantics (or meaning). The genetic or evolutionary fitness of a virus—characteristics such as how good it is at infecting a host—can be interpreted in terms of grammatical correctness. A successful, infectious virus is grammatically correct; an unsuccessful one is not.

> Similarly, mutations of a virus can be interpreted in terms of semantics. Mutations that make a virus appear different to things in its environment—such as changes in its surface proteins that make it invisible to certain antibodies—have altered its meaning. Viruses with different mutations can have different meanings, and a virus with a different meaning may need different antibodies to read it.

Semantic mapping possibilities: The preliminary animations above suggest two mapping possibilities, namely:

- associating prefixes with vertices of a polyhedron, and word-roots with the sides of that polyhedron
- associating prefixes with sides of a polyhedron, and word-roots with the prefixes of that polyhedron

The alternatives can be understood as related through the transformation of either into the other as its geometric dual (as illustrated above). Following Fuller, the fourfold minimal system can be understood as tetrahedral. This suggests the possibility of:

- conflating a set of prefixes into a set of four functional distinct generic variants
- conflating a set of word-roots into a set of four functional distinct generic variants

More complex polyhedral forms can be used to interrelate other patterns of prefixes and word-roots, of which the simplest are the following:

Prefix mapping possibilities of Platonic polyhedra			
octahedron	6 vertices (prefixes or word-roots)	cube	6 sides (word-roots or prefixes)
	8 sides (word-roots or prefixes)		8 vertices (prefixes or word-roots)
dodecahedron	20 vertices (prefixes or word-roots)	icosahedron	20 sides (word-roots or prefixes)
	12 sides (word-roots or prefixes)		12 vertices (prefixes or word-roots)

Topological operations on polyhedra as indicative of cognitive operations

In geometry, Conway polyhedron notation, as invented by John Horton Conway and promoted by George W. Hart, is used to describe polyhedra based on a seed polyhedron modified by various prefix operations. As described by *Wikipedia*:

> The simplest operator dual swaps vertex and face elements; e.g., a dual cube is an octahedron: *dC=O*. Applied in a series, these operators allow many higher order polyhedra to be generated. Conway defined the operators *abdegjkmost*, while Hart added *r* and *p*... Later implementations named further operators, sometimes referred to as "extended" operators... Conway's basic operations are sufficient to generate the Archimedean and Catalan solids from the Platonic solids. Some basic operations can be made as composites of others: for instance, ambo applied twice is the expand operation: *aa = e*, while a truncation after ambo produces bevel: *ta = b*.

Conway relational chart for polyhedra
(12 forms created from 3 operations: *dual*, *ambio*, *kis*)

Tomruen at English Wikipedia, Public domain, via Wikimedia Commons
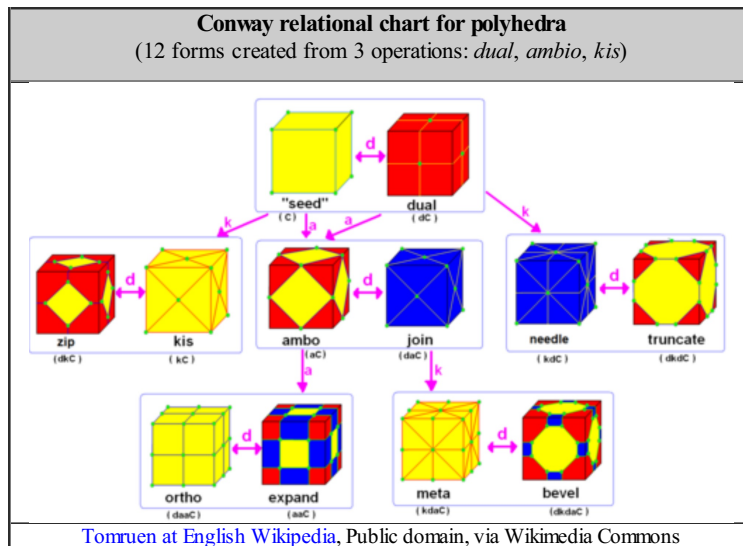
The extensive description in *Wikipedia* describes and illustrates more complex developments of the notation:

> Polyhedra can be studied topologically, in terms of how their vertices, edges, and faces connect together, or geometrically, in terms of the placement of those elements in space. Different implementations of these operators may create polyhedra that are geometrically different but topologically equivalent. These topologically equivalent polyhedra can be thought of as one of many embeddings of a polyhedral graph on the sphere. Unless otherwise specified...in the literature on Conway operators in general... topology is the primary concern. Polyhedra with genus 0 (i.e. topologically equivalent to a sphere) are often put into canonical form to avoid ambiguity.

Another approach to mapping the simpler polyhedral relationships is reproduced below from a separate discussion (*Pathway "route maps" of potential psychosocial transformation?* 2015).

Map highlighting distinctive relationships pathways between spherically symmetrical polyhedra (regular and semi-regular)
F=faces, E=edges, V=vertices (Total of these in parenthesis)
[Total reduced to prime number, other than 2, in square brackets]
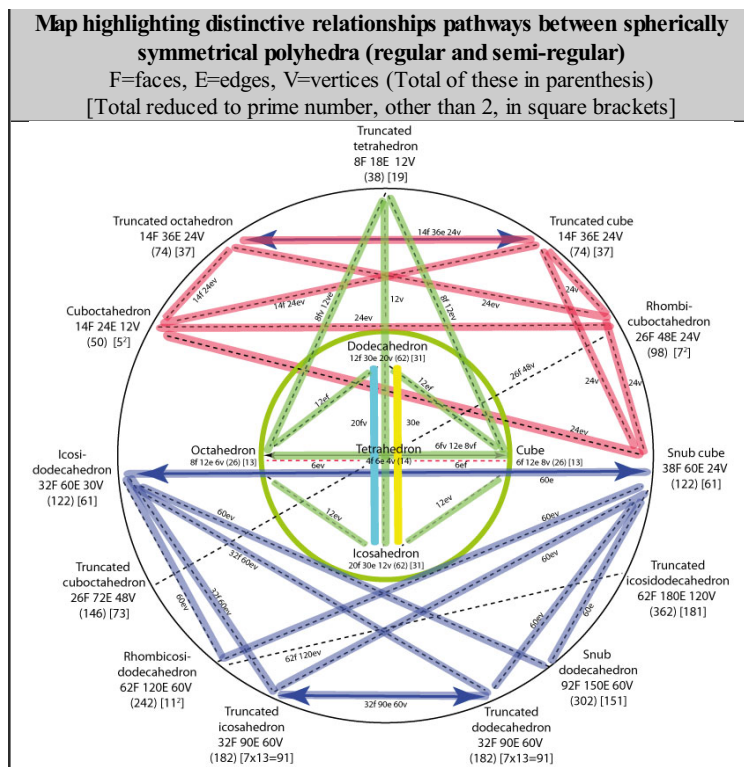
With respect to the argument here, **missing is of course any implication of how these "operations" might function in terms of cognitive systems**, and how they might be used to map the prefixes and word-roots in systemic terms **appropriate to the dynamics of any cognitive experience**.

Configuring cognitive systems -- from a general systems perspective

Elusive primary systems: Given Fuller's argument with respect to fourfoldness as a minimal systemic requirement, three special cases merit particular consideration, especially in the light of both their cognitive elusiveness: and their power of attraction

- **binary systems**: these characterize the only too evident challenges of divisive polarization in politics -- with corresponding patterns in many forms of social interaction, especially archetypal male-female relationships. They are however also fundamental to the obvious fascination of competitive sports from which the emergence of a singular winner is anticipated. (*Destabilizing Multipolar Society through Binary Decision-making: alternatives to "2-stroke democracy" suggested by 4-sided ball games*, 2016). Is the obvious challenge of bipartisan strategies of governance to be usefully compared to a corresponding "bipartisan" challenge to male-female relationships in marriage -- "marital bipartisanship"?

- **ternary systems**: this is evident in mystical comprehension of a trinity of divine forms -- or in the classic experiential challenge and dilemmas of the "eternal triangle" faced by mongamous binary relationships (*Triangulation of Incommensurable Concepts for Global Configuration*, 2011). Whilst use of "tripartisan" is relatively rare, tripartism is economic corporatism based on tripartite contracts between employers' organizations, trade unions, and the government of a country. The most striking instance is the unique tripartite organization of the International Labour Organization requiring discussion and approval from the representatives of governments, employers, and workers. There is now extensive exploration of a Triple Helix model of innovation, entangling academia, government and industry, as discussed separately (*Requisite curvature: reconciling the Triple Helix, the Triskelion and the Borromean condition*, 2018).

- **unitary systems**: clearly a major challenge to comprehension -- whether from the perspective of global integration, psychological integration or in terms of the quest of fundamental physics for a Theory of Everything. The singular winner anticipated in binary interaction is epitomized by the preoccupation with world leadership (at any cost), fundamental to the value systems and psychosocial narrative of nations such as the USA, and the imperial nostalgia of colonial powers. This is evident in the military doctrine of full-spectrum dominance and the fundamental assumption of most religions. It is appropriately dramatised by the *Highlander* (1986) -- whose tagline "There can be only one" has carried on into pop culture. Comprehension of unity -- despite the many appeals for it -- necessarily implies challenges which are only superficially addressed, as discussed separately (*Wholth as Sustaining Dynamic of Health and Wealth: cognitive dynamics sustaining the meta-pattern that connects*, 2013).

Parts of speech: The challenge to comprehension that these elusive dynamics variously constitute suggests that the relative stability of tetrahedral systems (as argued by Fuller) could be better reflected by contrasting understanding of prefix/word-root combinations in terms of three fundamental parts of speech: noun, verb, and adjective/adverb,

A tetrahedral system is a configuration of triangles, each composed of unitary "points" (vertices), binary "lines" (edges), and ternary "sides" ("faces"). This suggests that any cognitive mapping of prefix/word-root combinations, in terms of systemic functional significance, could consider the possibilities framed by the following table. This focuses questions as to whether and when:

- a prefix can better "carry" dynamic connotations implied by a verb, or qualitative connotations implied by an adjective/adverb

- a word-root can better "carry" static connotations implied by a noun, or qualitative connotations implied by an adjective/adverb

In any configurative mapping the response to the question would depend on whether the prefix/word-root combination was primarily understood as a noun (eg "a project"), a verb (eg "to project"), or an adjective/adverb (eg "projectivist"). The qualitative connotations of the latter suggest the need to address unresolved issues with regard to figurative language (*Questionable Classification of Figures of Speech -- as fundamental to the need for powerful rhetoric in governance*, 2016).

Correspondence between parts of speech and geometrical elements				
		Parts of speech		
		noun	*verb*	*adjective/adverb*
		(static implication)	(dynamic implication)	(qualitative implication)
Geometric elements	points/vertices	prefix	prefix	prefix
		word-root	word-root	word-root
	lines/edges	prefix	prefix	prefix
		word-root	word-root	word-root
	sides/faces	prefix	prefix	prefix
		word-root	word-root	word-root

These issues are partially addressed in conventional two-dimensional semantic mapping, most specifically in the mind-maps for teaching prefixes and suffixes by Reima Al-Jarf (*A Model for Enhancing EFL Freshman Students' Vocabulary with Mind-Mapping Software*, 2015). Unfortunately the focus in the maps offered there is primarily suffixes with some reference to negative prefixes only.

The two-dimensional mapping is however appropriately contrasted with a three-dimensional polyhedral mapping which effectively constitutes a cognitive "container" whose geometry (vertices, edges, faces) frames and constrains the possible cognitive operations. This is consistent with allusion to "in-the-box" thinking and the extensive commentary on the "container metaphor" articulated by George Lakoff and Mark Johnson (*Metaphors We Live By*, 1980).

Semantic 3D mapping is one of the most important fields in robotics, and has been used in many applications, such as robot navigation, surveillance, and virtual reality (Jongmin Jeong, et al, *Multimodal sensor-based semantic 3D mapping for a large-scale environment*, *Expert Systems with Applications*, 105, 2018, 1; Renato Martins. et al, *Extending Maps with Semantic and Contextual Object Information for Robot Navigation*, *arxiv.org*, 2003). It is of particular relevance to AI-enhanced dialogue (*Envisaging the AI-enhanced Future of the Conferencing Process*, 2020).

It may then be a matter of experiential preference as to whether prefixes (and their associated cognitive significance) are primarily mapped onto vertices -- using edges or faces to hold the connotations of the word-roots. Alternatively the morphing between geometric duals may be significance with respect to the cognitive dimension of semantic mapping

General systems: This argument is partly inspired by what was originally framed as general systems theory -- subsequently denatured by the primary concerns of systems theorists and cyberneticians, which tend to avoid an interdisciplinary approach to cognition and the wider challenges of experience, ignorance, comprehension, memorability, disagreement and strategic relevance.

This tendency would seem to be in process of reversal through the work of Yingxu Wang (*Towards the abstract system theory of system science for cognitive and intelligent systems. Complex and Intelligent Systems,* 1, 2015; *On Cognitive Foundations and Mathematical Theories of Knowledge Science*, *International Journal of Cognitive Informatics and Natural Intelligence*, 10, 2016, 2). Indications of this from those publications are presented in the schematic images below.

Systems approach to cognition and intelligence		
Formal knowledge system	Architecture of system algebra	Hyperstructural model of abstract systems
Reproduced from Yingxu Wang (2016)	Adapted from Yingxu Wang (2015)	Reproduced from Yingxu Wang (2015)
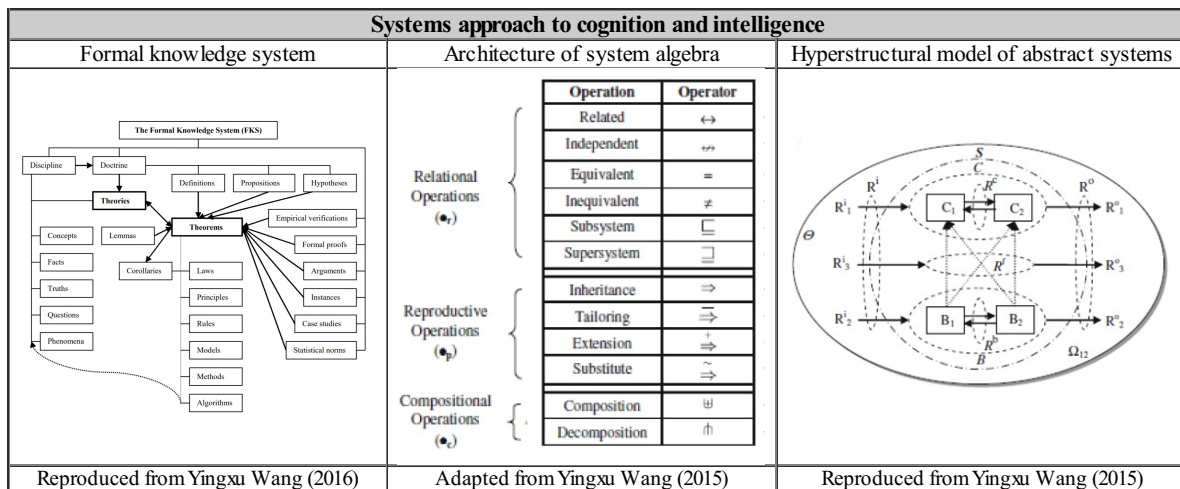
Wang (2015) articulates the system theory in terms of 5 Theories in the light of 28 Definitions (with 19 Corollaries). On the assumption that the articulation can be considered to be a system in its own right, this suggests the value of mapping those distinctions onto aa polyhedron -- in the light of the arguments above of Buckminster Fulller. As an exercise, possible polyhedra include the tetrated dodecahedron (12 pentagonal faces and 16 triangular faces) and its dual. Of potential relevance is that both have 28 faces and vertices.

Alternative mappings of the 28 definitions of Wang's abstract system theory (2015)	
Tetrated dodecahedron	Dual of tetrated dodecahedron

(28 faces, 28 vertices, 54 edges)	(28 faces, 28 vertices, 54 edges)

Animations made with *Stella Polyhedron Navigator*
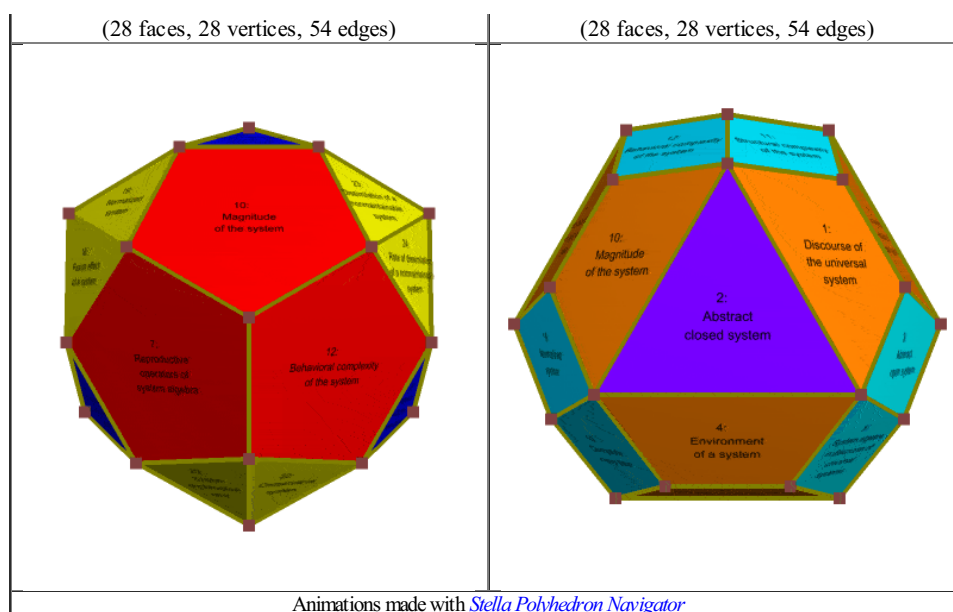
Following Rumsfeld's articulation (mentioned above), it is appropriate to challenge Wang's valuable articulation with what it appears to omit. This might be summarized in terms of:

- ignorance: as argued by Nicholas Rescher (*Ignorance: on the wider implications of deficient knowledge*, 2009)
- disagreement between proponents of theories and strategies: as argued by Nicholas Rescher (*The Strife of Systems: an essay on the grounds and implications of philosophical diversity*, 1985)
- comprehensibility and memorability, especially the erosion of collective memory (*Societal Learning and the Erosion of Collective Memory*, 1980)
- systems failure: as argued separately (*Variety of System Failures Engendered by Negligent Distinctions*, 2016)
- systemic exclusion: namely what is effectively defined as irrelevant (*Reintegration of a Remaindered World: cognitive recycling of objects of systemic neglect*, 2011)

A remarkable analysis of why things ought to work in theory is provided in a *magnum opus* by Fritjof Capra and Pier Luigi Luisi as *The Systems View of Life: a unifying vision* (2014). It is however also a remarkable example of why the global system is in such dire straits -- through failure to apply systemic insights to why they do not work in practice, as discussed separately (*Transcending an Asystemic View of Life*, 2014).

Polyhedral configurations of arrays of prefixes as cognitive operators

Arrays of prefixes: Polyhedral animations were used above to present a 12-fold array of prefixes. A more extensive array of prefixes and word-roots was then presented in tabular form. If prefixes are indeed indicative of distinctive cognitive functions, it is then appropriate to explore how many prefixes could be considered relevant to a cognitive system -- potentially in the light of viable system theory (if only as a preliminary exercise).

In this sense it is appropriate to note the checklists and commentaries in:

- a set of 20 examples of prefixes presented by English Study Here
- a set of 35 prefixes (Richard Nordquist, *35 Common Prefixes in English*, *ThoughtCo*, 10 September 2020)
- a set of 28 prefixes (*The Most Common Prefixes*, *English Grammar Today: Cambridge Dictionary*)
- a set of 48 prefixes (*List of Prefixes: Learn New Words Faster*, *English Hints*)
- a set of 149 prefixes (*List of English derivational prefixes*, *Wikipedia*), notably including number prefixes in English
- the comprehensive listings by Michael J. Sheehan (*Word Parts Dictionary: standard and reverse listings of prefixes, suffixes, roots and combining forms*, 2020)
- the comprehensive listings by Donald Borror (*Dictionary of Word Roots and Combining Forms*, 1960). This is compiled from Greek, Latin, and other languages, with special reference to biological terms and scientific names
- checklists of relevance to systemic study of the human body (*Word Parts and What They Mean*, *Medline Plus*; *30+ Medical Prefixes and Roots Worth Learning*, *English Hints*; *Common Prefixes, Roots and Suffixes in Medical Terminology*, *Pharmapproach*, 16 September 2020). These are potentially of particular relevance if there is focus on the healing metaphor (as indicated above)

Language variants? Despite the noted English bias of this exploration, the comprehensive list in the English version of *Wikipedia* can be usefully compared with the lists presented in other language versions of *Wikipedia*. These are potentially indicative of the more fundamental systemic functions in the light of their Greco-Latin origins -- and are also useful where clusterings are proposed.
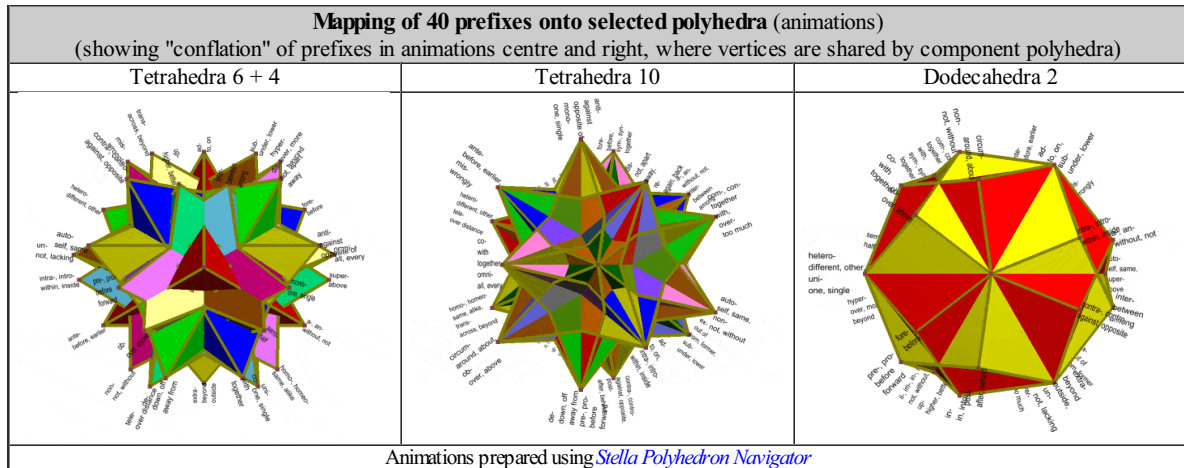
Number of prefixes indicated in other language versions of *Wikipedia*					
French	German	Italian	Spanish	Portuguese	Russian
17	25	22	33	12	56

Clearly questions of interest include both the potential size of arrays of prefixes (and the functions they may represent) and the degree of

polyhedral complexification required for its geometry to enable more extensive arrays of prefixes to be "carried" by it (with their functional implications).
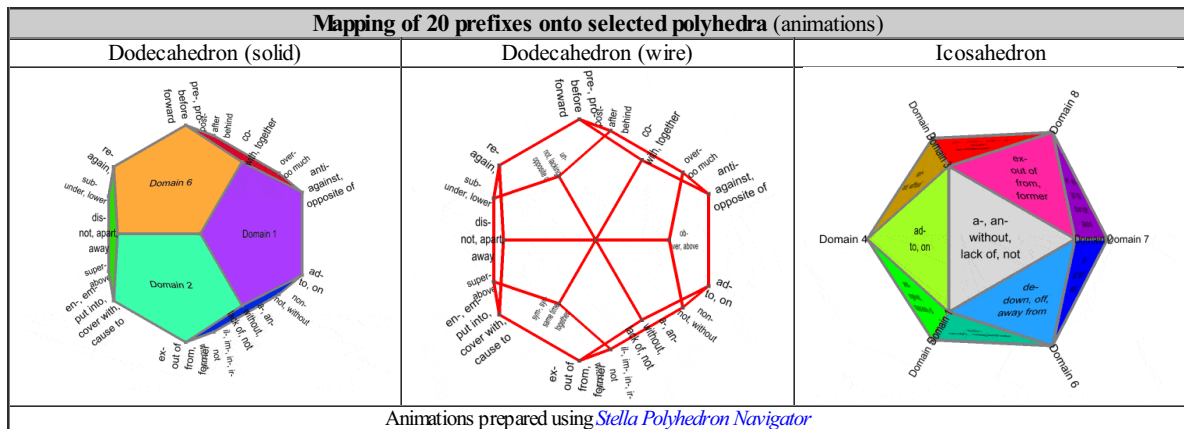
Mapping an array: In one exploratory exercise here the first two lists above were merged, including those in the table above, and (arbitrarily) reduced to a total of 40 items -- excluding prefixes indicative of equivalent functions. The criteria for inclusion and exclusion clearly merit much further consideration in the light of the more comprehensive sources listed above. Of interest is why a given list might include or exclude some prefixes, such as meta- or para-, for example.

The question is then how a set of 40 might be usefully configured on a polyhedron -- initially without considering their position in relation to each other. Examples are given in the animations below. The mapping is unique on the left but variously conflated in those centre and right, suggesting a future approach to compactification of significance. This followed an earlier exercise with respect to 40 strategic functions articulated in a report to the Club of Rome, as discussed separately (*Towards a higher order of coherent global strategic organization?* 2018).

Mapping of 40 prefixes onto selected polyhedra (animations)		
(showing "conflation" of prefixes in animations centre and right, where vertices are shared by component polyhedra)		
Tetrahedra 6 + 4	Tetrahedra 10	Dodecahedra 2
Animations prepared using *Stella Polyhedron Navigator*		

*** facet diag etc

As a further illustration of the approach, the number of prefixes included was (arbitrarily) reduced from 40 to 20 (as shown below), on the assumption that careful study would justify any such conflation due to duplication of functions.

Mapping of 20 prefixes onto selected polyhedra (animations)		
Dodecahedron (solid)	Dodecahedron (wire)	Icosahedron
Animations prepared using *Stella Polyhedron Navigator*		

Towards a more fundamental "periodic table": The organization of the constitutents of matter is framed at one level by the continuing quest for an appropriate periodic table of chemical elements -- for which there are currently numerous alternatives. The mathematics informing that organization continues to be a matter of debate (D. H. Rouvray and R. Bruce King (Eds.), *The Mathematics of the Periodic Table*, 2005; Jan C. A. Boeyens and Demetrius C. Levendis, *Number Theory and the Periodicity of Matter*, 2008). Physics frames a related quest in terms of a Standard Model of particle physics and known physical constants.

One remarkable effort to extend the metaphor of a periodic table to biology and culture is that of Edward Haskell (*Full Circle: The Moral Force of Unified Science*, Gordon and Breach, 1972). Arguably missing from the more conventional endeavours is exploration of the insights such thinking offers with respect to what really "matters" for many (*Quest for a "universal constant" of globalization? Questionable insights for the future from physics*, 2010; *Beyond the Standard Model of Universal Awareness*, 2010).

In the spirit of Gregory Bateson (*Angels Fear: towards an epistemology of the sacred*, 1988), this theme is explored separately (*Towards a Periodic Table of Ways of Knowing*, 2009) as an exercise based on assumptions detailed there in relation to:

- Towards a periodic organization of the *Mathematics Subject Classification*: use of the *Mathematics Subject Classification* (MSC) as implying a form of periodic table of mathematical ways of knowing, suggesting the possibility of "groups" and "periods". In contrast with the (above-mentioned) preoccupations of mathematical knowledge management regarding access, the emphasis is placed on employing the insights of mathematics into order and relationship so as better to configure the map as a whole -- if only to enable neophytes to navigate the terrain and discover territory they find meaningful..

- **Mathematics and metaphor**: cognitive understanding of mathematics, as indicated above (*Origin of mathematics and the periodic table -- in human cognition?*), The topic has been variously explored but it is useful to distinguish some possible "flavours", since some may be far from implying others. Annex 1 therefore cites authors distinguishing: Mathematics as metaphor, Metaphors of mathematics, Mathematical metaphors
- **Associating metaphor with formal representation: the *I Ching* of Chinese culture**: the mathematically interesting pattern of hexagrams of the *I Ching* of Chinese culture. The specific relevance here being the fact that metaphors are associated with the elements of the pattern to facilitate understanding of each and of the pattern as a whole
- **Comprehensive set of ways of knowing: the *All-Embracing Net* of Buddhist culture**: Of great relevance to explorations of any ordering of ways of knowing is that formulated in the *Brahmajala Sutta*. This is considered to be one of the Buddha's most important and profound discourses, weaving a net of sixty-two cases capturing all the philosophical, speculative views on the self and the world (Bhikku Bodhi (Tr). *The Discourse on the All-Embracing Net of Views; the Brahmajala Sutta and its commentarial exegesis*. Kandy, Buddhist Publications, 1978).

Suggestive "con-vergence" of "dis-parate" indications meriting "re-cognition"?

The suggestive indications variously presented or implied above could be seen as potentially indicative of a degree of convergence of conceptual "languages" -- for which a "Rosetta stone" is yet to be imagined. As with any engagement with diversity and the disparate, the degree to which each is considered distinct engenders deprecation of alternatives -- as exemplified by Margaret Thatcher's notorious assertion that There Is No Alternative (TINA). The nature of any such convergence is consistent with the title of the study by Gregory Bateson (*Angels Fear*, 1988), subtitled: *an investigation into the nature and meaning of the sacred.*

In such a context those efforts to associate disparate threads are of particular interest in that they embody the challenges of deprecation. The deprecation may well include dynamics familiar from the Galileo Affair, whereby the views of Galileo Galilei on heliocentrism were considered heretical. Such perspectives are typically excluded from any systemic analysis preoccupied with what is "right", given the perceived irrelevance of what is "wrong" -- despite the evident role of such perceptions in psychosocial dynamics (*Knowledge Processes Neglected by Science: insights from the crisis of science and belief*, 2012). To what extent does a specialist merit recognition as a "pseudophile" -- given the necessarily blinkered vision?

Cases of interest include

- **Isaac Newton**: Useful clarifications of the historical assessment of the complexity of Newton's role are now available (John T Young, *Isaac Newton's alchemical notes in the Royal Society. Notes and Records of the Royal Society*, 2006)). In addition to his contribution to science, in the period of the emergence of the Royal Society, his very extensive involvement with "alchemy" has long been been repudiated by contrast.
- **Arthur M. Young**, as designer of the Bell helicopter, who endeavoured to generalize his insights from control of a vehicle in 3D into the navigational challenges of metaphysics (*The Bell Notes: a journey from physics to metaphysics*, 1979). The generalization explored a 12-fold system whose relation to the symbolism of astrology he highlighted (*Geometry of Meaning*, 1976).
- **John G. Bennett**, who articulated *Systematics: a new technique in thinking* (1966) through the Institute for the Comparative Study of History, Philosophy and the Sciences in collaboration with Anthony G. E. Blake (*Principles of Systematics*; *Systematics and General Systems Theory*, *Systematics*, 1, 1963, 2). This reflected Bennett's intense involvement with Gurdjiefff, Subud and Sufism.
- **Frank Dodd (Tony) Smith**, whose book *PhiloPhysics* (2005) was banned by Cornell University, as with his many writings on the *arxiv.org* system that it maintains. This work describes some religio-philosophical systems and some physics models, with comments about some relevant interrelationships.

By what criteria are such polymaths to be recognized (as discussed in the *Wikipedia* profile), given the deprecation they evoke among contemporaries, especially when their interests extend beyond the sciences to include the arts and religion (not discussed in the *Wikipedia* profile)?

Insights from parallel computer memory organization: It is noteworthy that all of the above are scientists who crossed the boundaries of their disciplines -- as arguably expressed in terms of "thinking outside-the-box" in exemplification of "joined-up thinking". It is intriguing to note how such thinking is more recently exemplified by the pressures on effective design of memory organization of supercomputers, as discussed separately (*Framing Cognitive Space for Higher Order Coherence: toroidal interweaving from I Ching to supercomputers and back?* 2019). The latter compares the cubic organization of supercomputer memory with that of various understandings of an "eightfold way" as a "pattern that connects" (and gave rise to the following images).

The image below left is of the schematic design of a torus interconnect, namely a switch-less network topology for connecting processing nodes in a parallel computer system. The image below right indicates how the design metaphor may be further articulated. The logical operations of such a computer are constrained by the 16 Boolean connectives noted above -- now reframed to a degree by quantum computer operation with the use of quantum logic gates.
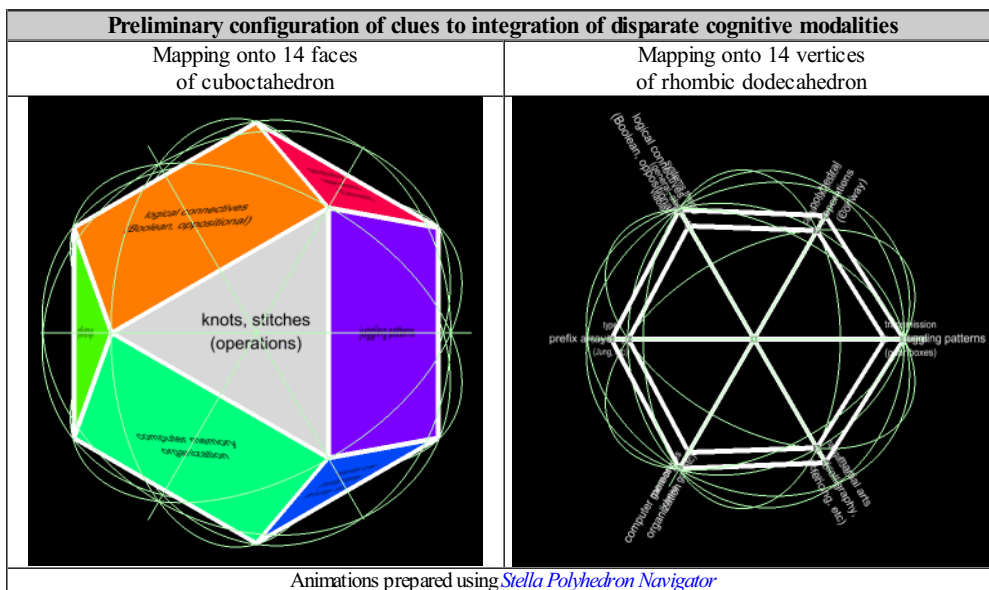
Representations in 3D of an interconnected 8-fold array		
Torus interconnect schematic (in cubic array)	**3D reconstruction of schematic on left** (animation with indicative cube)	Interlinking of a 3x3x3 set of 24 nodes (each linking 3 orthogonal loops)

Reproduced from *Wikipedia*	Reproduced from *Framing Cognitive Space for Higher Order Coherence* (2019)
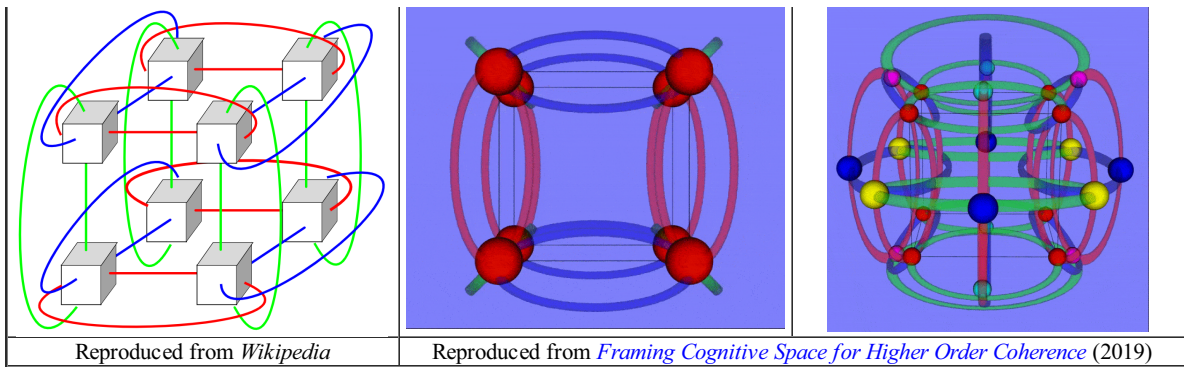
The pattern of the "conceptual model" of the supercomputer, as depicted above for that exploration, may therefore be used to distinguish (and map) mutually contrasting conceptual modes or languages. The image on the right below shows sections of this argument presented as two nodes in that schema. The six other domains discussed are also indicated in that schema. Understood as complementary, the suggestion is that these are potentially related by a pattern of correspondences -- although any such pattern is necessarily tentative at this stage. Whether these are sufficiently distinct to constitute requisite variety remains to be explored.

Representations variously associating distinctive significance with elements of an 8-fold array (Reproduced from *Framing Cognitive Space for Higher Order Coherence*, 2019)		
Cubical representation of *BaGua* pattern of *I Ching*	Animation of virtual variant (wireframe rendering)	Mapping of distinctive preoccupations onto 8-fold supercomputer/BaGua schematic
Reproduced from Z. D. Sung, *The Symbols of Yi King or the Symbols of the Chinese Logic of Changes* (1934, p. 12)	Virtual reality variants: vrml/wrl; x3d.	

Conflation dynamic? An indication of a possible integrative convergence is suggested by configuring the set of 14 "clues" in this argument using the dual polyhedra below.

Preliminary configuration of clues to integration of disparate cognitive modalities	
Mapping onto 14 faces of cuboctahedron	Mapping onto 14 vertices of rhombic dodecahedron
Animations prepared using *Stella Polyhedron Navigator*	

However arbitrary the exercise in the above mappings, of particular interest is the role of the rhombic dodecahedron in clarifying the issues of oppositional logic which are of relevance to the disparate nature of cognitive functions. Especially interesting with respect to the challenge of "collapsing" and "compactifying" semantic distinctions are the operations with which its dual -- the cuboctahedron -- is associated.

As extensively explored by Buckminster Fuller and others, these operations enable the cuboctahedron to be folded "into" an octahedron -- and even into a tetrahedron and 2D polygons -- via intermediary Platonic polyhedra of greater complexity (*Vector Equilibrium and its Transformation Pathways*, 1980). Hence Fuller's alternative name for the cuboctahedron as the vector equilibrum, and his naming of the dynamic of folding and unfolding as a jitterbug -- of which there are many accessible videos (*Buckminster Fuller's Jitterbug*, YouTube, 6 May 2007; *Buckminster Fuller Explains Vector Equilibrium*, YouTube, 29 November 2014). This has evoked extensive commentary (*Vector Equilibrium and Isotropic Vector Matrix*, Cosmometry; Joe Clinton, *R. Buckminster Fuller's Jitterbug: its fascination and some challenges*, YouTube, 24 May 2011). Distinct from Fuller's approach are those relating to Jensens' icosahedron.

Unfortunately no effort has been made to use this twisting collapse-and-expand dynamic for mapping purposes, since it suggests a means of "re-cognizing" the appropriate conflation of significance otherwise inhibited and confused by conventional labelling. Thus if the array of prefixes (for example) could be usefully mapped onto the 12 vertices of the cuboctahedron, this would offer a pathway for their conflation to a mapping of cognitive operations onto the 4 vertices of a tetrahedron, or to the 3 vertices of a triangle.

Seemingly unrelated is the role the cuboctahedron plays in configuring an integration of the semi-regular Archimedean polyhedra, as clarified by Keith Crichlow (*Order in Space: a design source book*, 2000) as illustrated below and discussed (*Packing and unpacking of 12 semi-regular Archimedean polyhedra*, 2015; *Increasing the dimensionality of the archetypal Round Table?* 2018). This complex of distinctive arrays can be understood as the articulation of the more fundamental 12-fold pattern.

Arrangement of the 12 Archimedean polyhedra in their most regular pattern	
a cuboctahedron, around a truncated tetrahedron (totalling 984 edges, 558 vertices, 452 faces)	
Arrows indicate the succession of truncations from 1 to 6 in each case.	Rotation of cuboctahedral array of 12 polyhedra (around an omitted 13th at the centre)
(from Keith Critchlow, *Order in Space*, 1969, p. 39).	Interactive virtual reality variant (.wrl)

Such explorations can be taken further by showing the 12 Archimedean polyhedra in icosahedral configuration emerging from a drilled truncated dodecahedron, as illustrated separately (*Necessity of encompassing a "hole: -- with a dodecameral mind?* 2018).

Eliciting coherence from configurations of prefix memeplexes

As suggested above, a limited set of cognitive operations may well be indicated by prefixes -- but understood more abstractly and subtly than is too readily inferred from conventional labels. To preclude reductionist assumptions suggested by the conventions of labelling by words in a particular language, there is therefore a case for understanding these operations as experiential memeplexes more appropriately denoted by numbers (or symbols such as the Chinese trigrams, hexagrams, or tetragrams).

Following Fuller's argument, a point of departure is a 4-fold tetrahedral pattern of memeplexes implied by a set of prefixes. At this level of abstraction, it is studies based on the insights of Carl Jung which may be especially relevant, such as the work of Marie-Louise von Franz (*Number and Time: : reflections leading toward a unification of depth psychology and physics*, 1974). This was informed by the interactions of both of them with the physicist Wolfgang Pauli (C. A. Meier, *Atom and Archetype: the Pauli/Jung Letters, 1932-1958*, 2001; Arthur I. Miller, *137: Jung, Pauli, and the Pursuit of a Scientific Obsession*, 2010).

Given the discussion of the cubic configuration (above), and an assumption that it is more readily comprehensible, that configuration may be more usefully formed by 2 tetrahedra whose 8 vertices then serve to define the 8 vertices of the cube. This is illustrated in the two variants of the image below.

The adaptation of the images of the cubic array, as presented below right, offers a sense of the potential interconnectivity that might be expected in an 8-fold memeplex derived from a set of prefixes. Using the changes implied by the *Bagua* trigram encoding, these suggest a degree of symmetry between the different types of connectivity through alternation of: top lines (red); middle lines (blue); bottom lines (green); with double line changes across surface diagonals and triple line changes through the centre of the cube). The nature of binary opposition associated with triple line changes is especially evident in the image on the left with the shift from one tetrahedron to another.

Interconnectivity on a cubic array		
Double tetrahedron		
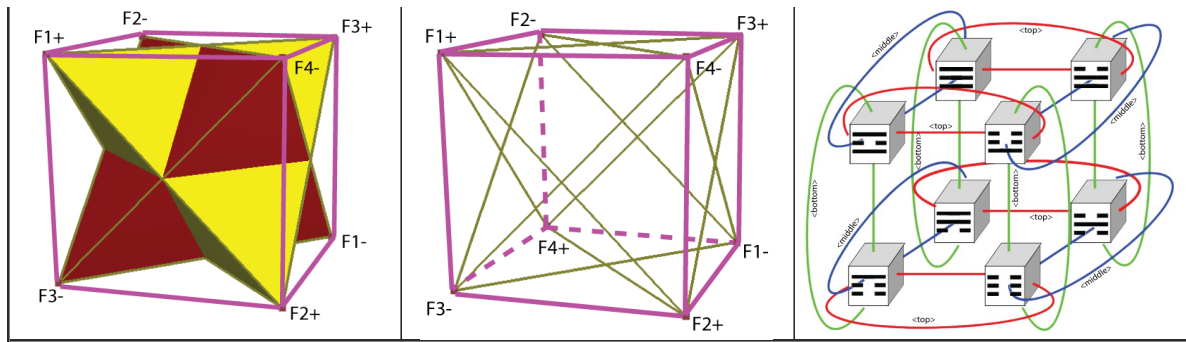
With the "ob-server" especially identified with the centre of such an array of operations, of particular interest is the manner in which the above images are variously indicative of how the following cognitive patterns of (prefix) memeplexes are coherently interrelated:

- 2-foldness of the diagonally opposing vertices of the cube
- 3-foldness of the diagonal planes of the cube
- 4-foldness of the embodied tetrahedral structures defining the cube
- 6-foldness of the sides of the cube
- 8-foldness of the vertices of the cube
- 12-foldness of the edges of the cube

Somewhat curiously the box-like cubic representation offers a more limited sense of coherence in contrast to the dodecahedron and icosahedron (as presented above) in which the articulation approximates more closely to that of a sphere -- with the coherence that implies, despite the increasing complexity of the configuration:

- 12-foldness of the sides of the dodecahedron and of the vertices of the icosahedron
- 20-foldness of the vertices of the 5-edged sides of the dodecahedron and of the 3-edged sides of the icosahedron
- 30-foldness of the edges of both the dodecahedron and the icosahedron

The 30-fold structure of the icosahedron is fundamental to the cybernetic arguments of Stafford Beer (*Beyond Dispute: the invention of team syntegrity*, 1994) and the related insights into a viable system. Whilst development of the latter has focused on the implication for organizations, there are clearly implications for the cognitive organization of the manner of operation and comprehension of any system and the "sub-jective" embedding of the "ob-server" within it.

The argument with respective to comprehension of 12-foldness can be developed further (*Time for Provocative Mnemonic Aids to Systemic Connectivity? Possibilities of reconciling the "headless hearts" to the "heartless heads"*, 2018). This explores the following:

Eliciting the dynamics of the cube: reframing discourse dynamics	Associating significance with a dodecahedron
	Increasing the dimensionality of the archetypal Round Table?
Association of the Szilassi polyhedron with cube inversion	Necessity of encompassing a "hole" -- with a dodecameral
Dynamics of discord anticipating the dynamics of concord	mind?

One focus there is whether and how the conventional rigidity of the cube -- as the antithesis of the sphere -- could be understood as allowing for a paradoxical dynamic of inversion, with its implication for the relation between "ob-jectivity" and "sub-jectivity". A second focus extended the polyhedral argument to the cuboctahedron, the drilled truncated cube and the drilled truncated dodecahedron in order to enable greater complexity to be carried by associated dynamics.

Cognitive implications of calligraphy: bird's nest and "nesting failure"

Calligraphy: There is no lack of contrasting references to the cognitive significance of calligraphy. These include:

- *handwriting psychology*: preoccupied with determining character through graphical analysis
- *neuroscience and reading/writing*:
  - Nandini Chatterjee Singh and Chaitra Rao: *Reading in Devanagari: Insights from functional neuroimaging* (*Indian Journal of Radiology and l Imaging*. 24, 2014, 1) usefully reviews the use of MRI to obtain a comprehensive understanding of the neural network underlying visual word recognition in a variety of languages
  - Edoardo D'Anna: *Brain Calligraphy: a paradigm shift for brain-based communication*. *Psychology Today*, 11 July 2020) discusses the possibility, in the light of neuroscience, of how to transfer words from the brain to digital media by imagining key strokes (
- *cognitive calligraphy*: referring allusively to the role of calligraphy in framing culture, but seemingly without a specific focus on the distinctive cognitive functions thereby cultivated
  - Dmitry Petrovsky: *Cognitive calligraphy* (*International Exhibition of Calligraphy*, 2021?)
  - Petr Chobitko: *Cognitive Calligraphy* (*National Union of Calligraphers*, 2021??)
- *therapeutic calligraphy*: as a special kind of handwriting with a brush, Chinese calligraphic handwriting requires a large amount of practice with high levels of concentration and emotion regulation. It has been used as a cognitive intervention strategy among older adults or people with mild cognitive impairment:
  - Chetwyn Chan: *Calligraphy Writing for Cognitive and Emotional Enhancement Among Older MCI People* (*Clinical Trial*s, 29 April 2016); *Chinese Calligraphy Writing for Augmenting Attentional Control and Working Memory of Older Adults at Risk of Mild Cognitive Impairment* (*Journal of Alzheimer's Disease*. 58, 2017, 3)

- Henry Kao: *Calligraphy Therapy: a complementary approach to psychotherapy* (*Asia Pacific Journal of Counselling and Psychotherapy* 1, 2010, 1)
- Wen Chen. et al: *Long-term Chinese calligraphic handwriting reshapes the posterior cingulate cortex* (*PLoS One*, 14, 2019, 4)

With respect to the argument here, these preoccupations are primarily significant in alluding to insights which might be gained from reframing their concerns otherwise. Potentially more suggestive is the review by Ana Dussert (*On-line Calligraphy*, *Lacanian Review Online*, 29 June 2019):

> In his teaching and most particularly in the '70s, Lacan was inspired by Chinese and Japanese writing in order to elaborate what first occurred in his psychoanalysis as letter in terms of signifier and then got separated from the signifier and got established in the real: the letter as what grasps, what shapes the body in its jouissance outside meaning. The calligraphy contributes to this immanent reversal...
>
> Calligraphy takes the place of what is supposed to be that of the analyst in the Western discourse: Lacan plays on words by saying that if the calligrapher needs a brush, stylo, he himself needs a style... The letter is the object *a*, the impossible reference of the discourse which materializes the definitive act of castration itself; it tries to produce the obliteration of the subject in the act of writing itself. It directly engages the enjoyment that has traversed the fantasy: not as repressed, but as obliterated, as crossed out in the gesture of writing itself. That is why we speak of calligraphy not only as a technique of writing in its aesthetic aspect, but also as a bodily practice of enjoyment in its trace.
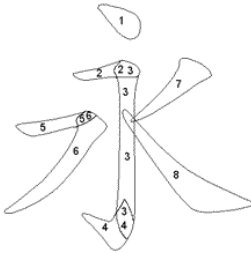
Missing from the above preoccupations are the cognitive insights associated with using the distinctive strokes in the writing process. This is helpfully articulated to some degree by physiotherapist Pam Versfeld (*Teaching Handwriting: a stroke based approach*, *Skills for Action*):

> A stroke based approach to learning to print letters is a matter of building a library of motor plans for the different combinations of strokes that are used for producing letters and numbers, so that a letter, or series of letters to be preplanned and produced without need for visual guidance. An important aspect of this learning is the increasingly strong and automatic association between the sound of the letter (phoneme), the shape of the letter (grapheme) and the motor plan for the letter.

Of potentially remarkable relevance is the thinking with regard to the elaboration of the most aesthetic form of a Chinese character (as in widely practiced Chinese calligraphy), using eight common strokes in regular script, according to the *8 Principles of Yong*, as discussed separately (*Anticipating When Blackbirds Sing Chinese*, 2014). This is illustrated with the character *yong*, signifying "forever" or "permanence". In Japan the principles (and the associated 72 types of "brush energy") were the focus of the Daishi school of calligraphy associated with Kukai.

There is a strong case for exploring what is understood by **yong in relationship to "sustainability" -- as it is now so widely used with respect to strategic issues of governance.** Of particular relevance with respect to calligraphy are the cognitive and philosophical associations in the process of elaborating a character, as cultivated within the Zen tradition. The same may well be evident in Arabic script and other scripts considered sacred in some way.

Eight Principles of Yong regarding formation of Chinese characters (images from *Wikipedia*)		
Stroke order (animation)	Strokes numbered (strokes overlap briefly where there are multiple numbers in an area)	Strokes together and separated

Martial arts? It is appropriate to note the association of calligraphy with the martial arts (*Calligraphy or the Seventh Martial Art*. *Physical Arts*). The latter notes that: *The spontaneous stroke of the brush is reminiscent of the quick free thrust of the sword or the freedom of the arrow fired effortlessly -- wherever there is distress, worry or swiftness of action.*

Haiku have a similar relation to the cognitive significance of the martial arts, as argued separately (*Ensuring Strategic Resilience through Haiku Patterns: reframing the scope of the "martial arts" in response to strategic threats*, 2006; Joseph Truncale, *Martial Arts and Warrior Haiku and Senryu*, 2017). For Elizabeth Nichols:

> The art of writing *haiku* requires an immediacy of consciousness, being present in the moment (*Japanese poetic forms: haiku and martial arts*, *International Journal of Applied Psychoanalytic Studies*, 5, 2008, 2)

Strategic significance continues to be associated with another martial art through the Eastern fencing classic *The Book of Five Rings* (1643). In the tradition of western swordsmanship, the swordsman is understood to be able to adopt essentially 14 recognizable and effective fighting postures (guards/wards/stances) overall. Of these five are major universal ones that correspond to High, Middle, Low, Hanging, and Back positions. Fencing theory specifies a set of these positions either on guard in preparation for defence against attack or in preparation for attack.

Parries deflect the attack by simply moving in a variety of directions, from one position to another. These positions are distinguished as: Prime, Seconde, Tierce, Quarte, Quinte, Sixte, Septime and Octave. Fencers thus have a set of moves that they can apply in different strategies, although the time between fencing moves or turns is measured in milliseconds (cf Nick Evangelista, *The Inner Game of Fencing: Excellence in Form, Technique, Strategy and Spirit*, 2000; *The Art and Science of Fencing*, 1999).

The fencing metaphor is readily applied to debate as a martial art, emphasized by skill in "marshaling" arguments. Most unfortunately the art of debate and dialogue has deteriorated to the point of becoming a lost art. The art has been lost in the science of triumphalist competition from which "unity" is naively expected to emerge (*Pointless verbal fencing hindered attempts to discuss a settlement for the North*, *The Irish Times*, 30 December 2008).

For Glen Whitman:

> Debate is, fortunately or not, an exercise in persuasion, wit, and rhetoric, not just logic... Logic is a useful tool in this process, but it is not the only tool -- after all, "plausibility" is a fairly subjective matter that does not follow strict logical rules... Besides, let's be honest: debate is not just about finding truth, it's also about *winning*. If you think a fallacious argument can slide by and persuade... you're going to make it, right? The trick is not getting caught (*Logical Fallacies and the Art of Debate*).

This tends to be far from the emphasis offered by Sally Shalabi (*Verbal Fencing*, *Shalabieh's World*, March 2008):

> The word play between two is a seduction, a game of flirtation even. It is a matching of wits, a battle of intellect and language. I enjoy this battle more than any other. But this game of words and humor, can either be invigorating or utterly exasperating. I engage in verbal play with people all the time. If it is any good it could possibly lead to mental intercourse, something that is very pleasurable and always desirable for me. If it is bad then I'm left feeling like a cold fish.

"Cold fish" is only one of the appropriate metaphors for the prevailing poisonous debate between opposing perspectives around the globe, each engaged in a pre-scripted "holy war" -- a "verbal jihad" in defence of the truths they respectively uphold.

A traditional corrective is clarified by Malcolm Keating (*In Nyaya philosophy only some debates are worth having*, *Aeon/Psyche*, 2 December 2020). One remarkable contrasting example is to be found in the Basque tradition of bertsolaritza (*Improvisation in Multivocal Poetic Discourse: Basque lauburu and bertsolaritza as catalysts of global significance*, 2016).

Eliciting the "unity" of an integrative perspective may indeed benefit from the metaphor of "mental intercourse", especially when this involves the interplay of a multiplicity of contrasting perspectives, rather than the triumph of any one of them to the exclusion of others (*"Human Intercourse": "Intercourse with Nature" and "Intercourse with the Other"*, 2007). Understood as a dynamic array, in nature this can be recognized as implying the construction of a "nest".

Bird's nest and "nesting failure"? A current insight with regard to complexity is that "everything is connected to everything", exemplified by studies to the effect that there are on average six degrees of separation (or fewer) between people in terms of their social connections. However it has yet to be inferred that this is equally true of problems people perceive or values that they uphold.

The "everything is connected to everything" argument has given rise to recognition of problematic "hairballs" in new data visualization techniques (Christian Miles, *Untangling the Hairball: visualizing Donald Trump's network*, *Cambridge Intelligence*, 6 February 2017; Dan *Williams, Graph Visualization: fixing data hairballs*, *Cambridge Intelligence*, 25 November 2019; Hans-Jörg Schulz, *Grooming the Hairball: how to tidy up network visualizations?*, 2013).
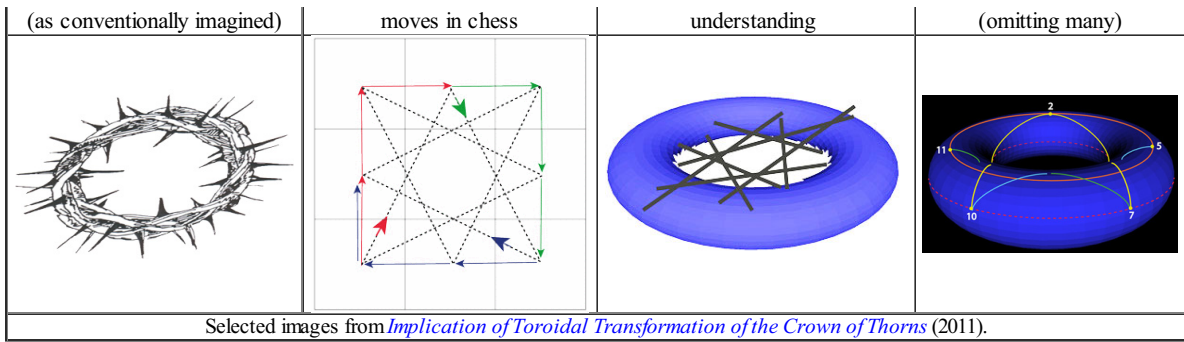
Whilst the role of bird's nests at the origin of Chinese characters is recognized, as with their role as a symbol (*"Bird's Nest" might be the symbol of modern China*, *People's Daily Online*, 4 September 2008), of some relevance to this argument is the resemblance of such characters to the confusing process of constructing bird's nests -- in the eyes of non-Chinese (and of non-birds).

In constructing a nest with many twigs, a bird typically configures the pattern of twigs in a circular fashion -- necessarily in 3D -- with an empty centre in which any eggs are laid and the young are nourished. By contrast, a data hairball typically has all relationships configured in a haphazard manner, or tightly clustered around a central point -- typically in 2D.

Where efforts are made to configure relationships around a circle, consistent with the archetypal metaphor of the Round Table, the disconnect between such relationships can be understood as constituting a problematic Crown of Thorns, even when they form triangular or other patterns across the circle. The transformation of this condition is discussed separately in relation to the pattern of Knight's moves of chess and other games (*Implication of Toroidal Transformation of the Crown of Thorns: design challenge to enable integrative comprehension of global dynamics*, 2011).

An animation of the pattern of such moves is presented below -- in contrast to the absence of any pattern of joined-up thinking (a failure to map the Knight's moves to curvature?). A final image (below right) offers an indication of conformity to a torus.

Transformation from a "crown of thorns" to a "bird's nest"			
Crown of Thorns	Animation of 8 of the Knight's	Indication of unjoined-up	"Lines" of moves as "curves"

(as conventionally imagined)	moves in chess	understanding	(omitting many)
Selected images from *Implication of Toroidal Transformation of the Crown of Thorns* (2011).			

Given such allusions, a bird's nest is curiously comparable with the traditional mandala as a configuration of cognitive functions -- typically in 2D. The challenge for the meditator is to configure them in 3D or otherwise. Potentially more curious is the manner in which the logos of many collective initiatives bear comparison with mandalas -- and therefore bird's nests -- raising the question as to how these might be configured and experienced in 3D (*Eliciting Insight from Mandala-style Logos in 3D: interactive engagement with mandalas and yantras in virtual reality*, 2020). An interpretation of the mandala as a political model is used to counterbalance modern tendencies seeking forms of unified political power.

Cognitively the challenge of comprehension has been most usefully addressed using the mathematics of q-analysis developed by Ron Atkin (*Multidimensional Man; can man live in 3-dimensional space?*, 1981), as separately summarized (*Comprehension: Social organization determined by incommunicability of insights*). As illustrated (below right), Atkin illustrates the challenge of comprehension of "white" in relation to experience "within" the geometry of a single triangle -- a challenge potentially greater "within" the 4 interlocking triangles of any 12-fold Round Table.

It is intriguing to note the obvious necessity of the central hole in the bird's nest -- and as implied in the configuration of those seated at a Round Table. Of potential relevance to its role in relation to innovation are the arguments of Terrence Deacon (*Incomplete Nature: how mind emerged from matter*, 2012):

> Basically, it means that our best science -- that collection of theories that presumably comes closest to explaining everything -- does not include this one most defining characteristic of being you and me. In effect, our current "Theory of Everything" implies that we don't exist, except as collections of atoms. So what's missing? **Ironically and enigmatically, something missing is missing**. (p. 1, *emphasis added*)

As noted separately (*Cognitive mystery of holes, lacunae and incompleteness*, 2014), of particular relevance is the remarkable exploration by Roberto Casati and Achille C. Varzi (*Holes and Other Superficialities*, 1994) -- with respect to the borderlines of metaphysics, everyday geometry, and the theory of perception.

The animation (below far-right) is reproduced from an earlier discussion (*Eliciting a Universe of Meaning: within a global information society of fragmenting knowledge and relationships*, 2013). This explores the 12-fold pattern of Arthur Young (*Geometry of Meaning*, 1976) -- as 12 cognitive navigational principles suggestive of the experiential system of interwoven creative processes ("12 Principles of Young"?) This employs his encoding of the distinctive processes in the form of zodiacal signs -- in contrast to other ideograms descriptive of systemic and logical relationships (as with those above of Yingxu Wang, notably in relation to his hyperstructural model of an abstract system, especially given its resemblance to a bird's nest).

Comprehension through transcending the plane			
As indicated by the q-analysis of Ron Atkin		Extending Atkin's example to a 12-fold pattern	
Conjection as recognizing "white"	Relative orders of comprehension	Emergence of an "egg"	Distinctive cognitive functions
	0-dimension: Red, Green or Blue **1-dimension:** Yellow (=Red/Green) Purple (=Red/Blue); or Turquoise (=Blue/Green) **2-dimension:** White (=Red/Green/Blue)		
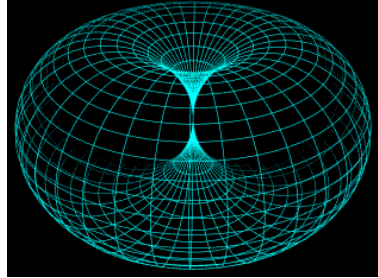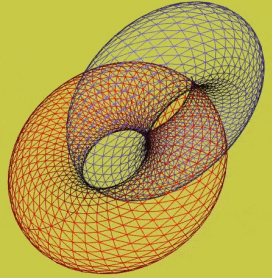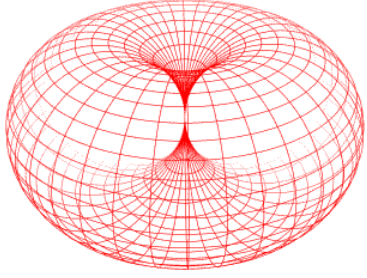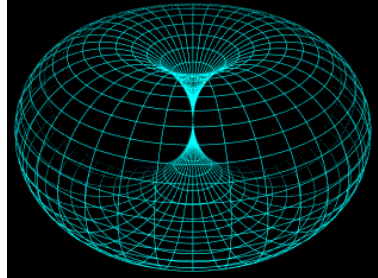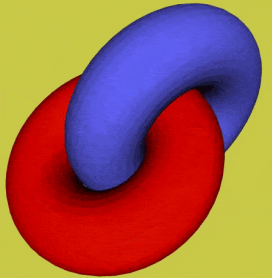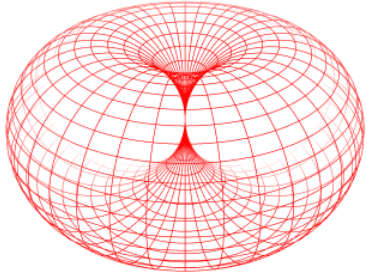
Arguably it is the expectation that, in governance terms, any Round Table will be enabled to "lay an insightful strategic egg" and to nourish what emerges -- as with a nesting bird. Given the considerable importance attached to birds in relation to decision making in the Roman Empire through augury, there is the ironic possibility that global governance may now have much to learn from "nesting failure". This is variously recognized as due to destruction of the nests, their abandonment, to predation, the death of the nestlings, or to egg collectors.

With widespread adoption of incubator as a metaphor, most notably with respect to innovation in technopoles, the failure of any integrative initiative could be understood both as a "nesting failure" or a failure of incubation. Although the etymology is somewhat uncertain, the cubic interconnectivity (discussed above) suggests a correspondence with "in-cubation" as a key to the creativity with which an egg is metaphorically associated.

Exploring the paradoxically requisite cognitive twist of higher dimensionality

Toroidal insights: As indicated and illustrated above, the memory organization of a supercomputer now involves what is described as a torus interconnect -- a switch-less network topology for connecting processing nodes in a parallel computer system. However the issue here is how to explore the cognitive implications of a toroidal focus, as discussed separately (*Imagining Toroidal Life as a Sustainable Alternative: from globalization to toroidization or back to flatland*? 2019; *Framing Cognitive Space for Higher Order Coherence: toroidal interweaving from I Ching to supercomputers and back?* 2019).
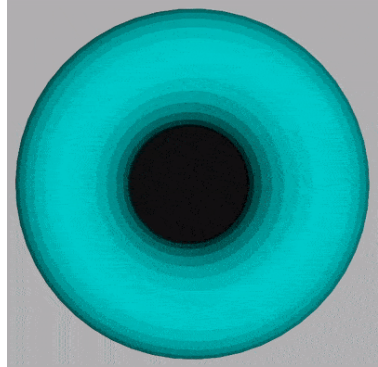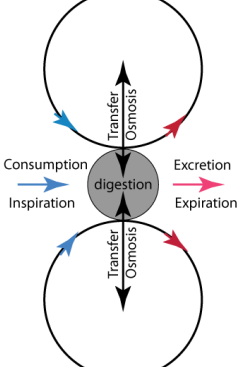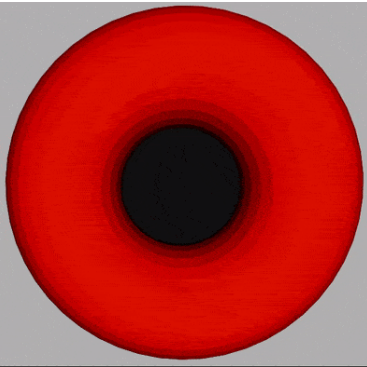
Torus interlocking: The animations below clarify distinctions of directionality and orientation in considering the psychosocial implications of torus interlocking. A possible variant is the relative size of the inner radius "through" the torus in comparison with the radius of the torus "ring". The "hole" may be highly constricted or may be of a size permitting two tori to interlock, as shown in the central images with the matching directionality of their rotations. The latter are of course suggestive of the fundamental nature of intercourse.

Dynamics of torus interlocking		
Animation right to left	*Animation of interlocking*	*Animation left to right*
with "in" at "top"	counter-rotations visible (one example)	with "in" at "top"
with "out" at "top"	counter-rotations not visible	with "out" at "top"
Animations adapted from those kindly produced by Sergey Bederov of Cortona3D		

Arguably the most fundamental cognitive processes implied by an array of prefix memeplexes are those relating to consumption, digestion and excretion -- generically understood in terms of the principles of general systems theory and their application to information processing. The dynamics of potentially associated with a torus, as illustrated above, can then be adapted below to indicate this schematically.

The suggestion is that an inward dynamic (below left) characterizes consumption and the processes of capture that precede it. Effectively "hidden" processes of digestion take place within as indicated by the dark sphere -- associated with a transfer from the sphere to the torus, followed by a process of excretion (below right). According to the metaphors of alchemy, the central sphere might be compared with an athanor in which alchemical digestion takes place -- namely one of the 12 core processes in the alchemical "magnum opus".
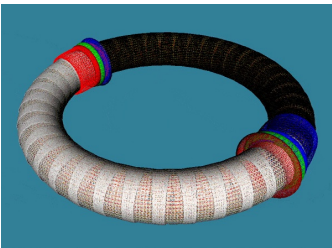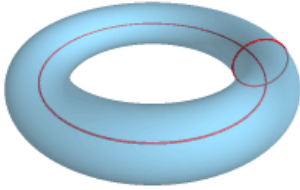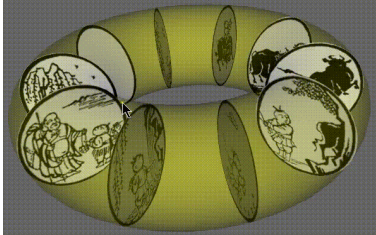
Schematic indications of toroidal "digestion" within a central sphere		
(recolouring the torus from "consumption" to "excretion")		
Animation of "consumption"	Cross-section view	Animation of "excretion"
Animations adapted from X3D models kindly produced by Sergey Bederov of Cortona3D		

Of particular interest is the nature of the transfer during "digestion", namely the transfer from outside to inside, as may be variously discussed (*Cognitive Osmosis in a Knowledge-based Civilization: interface challenge of inside-outside, insight-outsight, information-outformation*, 2017; *World Introversion through Paracycling: global potential for living sustainably "outside-inside"*, 2013). Of further interest is an implied dynamic (*Alternation of worldview between "inside-outside" and "outside-inside"*, 2013; *Living as an Imaginal Bridge between Worlds: global implications of "betwixt and between" and liminality*, 2011).

Symbolic clues: The traditional cosmological symbol of the Ouroboros can be understood as a recognition of the consumption/excretion process. A schematic animation can be used to elaborated to illustrate this, as presented below left (*Experimental animations in 3D of the ouroboros pattern*, 2017). There is a case for recognizing the traditional sequence of Zen ox-herding images as indicative of an engagement with insight of ever higher order -- potentially framed within a torus as reproduced below right from an earlier discussion (*Zen of Facticity: Bull, Ox or Otherwise?* 2017).

With respect to the wholeness of globality symbolized by the sphere, the paradoxical topological transformations of the central animation offer an indication.
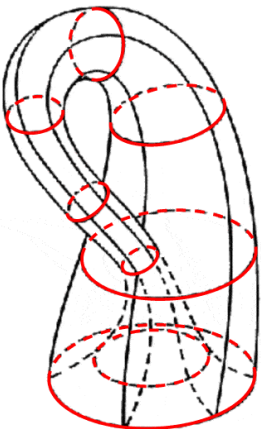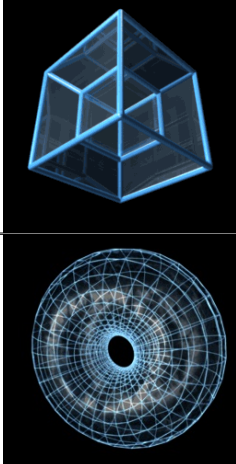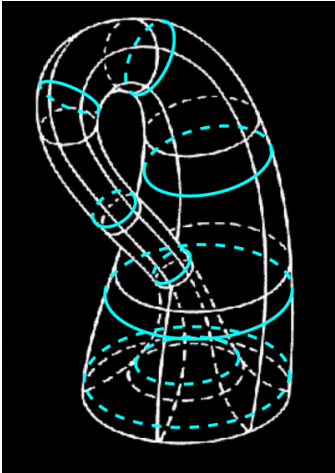
Comparable toroidal animations?		
Schematic ouroboros animation	Ring torus becomes a horn torus, then a spindle torus, and finally degenerates into a sphere.	Animation of simplest torus as container for dynamic cognitive relations
From: *Experimental animations in 3D of the ouroboros pattern* (2017)	User:Kieff [Public domain], via Wikimedia Commons	From: *Zen of Facticity: Bull, Ox or Otherwise?* 2017

Paradoxical higher dimensionality: Insights into the requisite cognitive twist can be variously discussed, notably in terms of enantiodromia as a process of psychosocial significance (*Enantiodromia: cycling through the "cognitive twist"*, 2007; *Clarifying subtle complexity and a necessary "cognitive twist"*, 2019; *Necessary cognitive twist: star symbols as bladed propellers -- for propulsion in 3D?* 2018; (*Sphere eversion as guide to the cognitive twist of global introversion?*, 2013).

The nature of the cognitive paradox in relation to the torus has been most fruitfully articulated -- in the light of the challenges of the Necker cube, the Mobius strip, the leminscate and the Klein bottle -- by Steven Rosen (*Topologies of the Flesh: a multidimensional exploration of the lifeworld*. 2006; *Dimensions of Apeiron: a topological phenomenology of space, time, and individuation*, 2004; *Science, Paradox and the Moebius Principle: the evolution of a "transcultural" approach to wholeness*, 1994).

Visualizations of the paradox are most readily illustrated by the Mobius strip. More challenging is the presentation of a potential cognitive dynamic in terms of the Klein bottle. One approach is that in the animations (left and right below) developing further the dynamics of the "consumption/excretion" metaphor presented above in relation to the torus.

Far more elegant indications of the paradoxical impossibility are the animations of the tesseract and the Clifford torus (below centre).

Towards comprehending the requisite "cognitive twist" of higher dimensionality		
Klein bottle animation with potentially associated cognitive dynamics ("out" to "in"?)	Tesseract animation simulating requisite 4-dimensionality? (by Jason Hise [CC0], via Wikimedia Commons)	Klein bottle animation with potentially associated cognitive dynamics ("in" to "out"?)
	  A stereographic projection of a Clifford torus performing a simple rotation through the xz plane. (Created by Jason Hise with Maya and Macromedia Fireworks)	

Cognitive embodiment of knots: knotting and knitting processes

Diagrammatic limitations: The images above, however animated, may well be understood as alienating in relation to the cognitive

abstraction which they could imply. This is an issue addressed by Elizabeth de Freitas and Nathalie Sinclair (*Diagram, Gesture, Agency: theorizing embodiment in the mathematics classroom*, *Educational Studies in Mathematics* 80, 2012, 1-2). The authors argue that:

> Recent research has begun to identify specific patterns in student and teacher use of gesture to construct and communicate mathematical meanings..., pointing out how teachers leverage mimetic gesture in reifying student knowledge... and exploring the way that gestures act iconically, indexically, and symbolically,,, Much of this work conceives of diagrams and gestures as "external" representations of abstract mathematical concepts or cognitive schemas. According to this approach, the diagram is assigned a static completeness, while the gestures -- and the hands -- that the diagram mobilized are forgotten. The diagram is then demoted to merely an illustration or representation of some other more fundamental or prior concept, while the gestures through which it emerged are erased from the text....
>
> We argue for a fundamental philosophical shift to better conceptualize the relationship between gesture and diagram, and suggest that such an approach might open up new ways of conceptualizing the very idea of mathematical embodiment.... Diagramming and gesturing are embodied acts that constitute new relationships between the person doing the mathematics and the material world. It is this ontological coupling of the gesture and the diagram that we are interested in. Not only does it draw together two areas of scholarly focus in mathematics education on gestures and diagrams, but, in so doing, it offers new ways of thinking about embodied cognition and agency in mathematics.

Knotting: The implications of that argument are of particular relevance to knots and knotting which have achieved symbolic significance in some cultures. This has been a focus of a recent study (Zahra Vahedi, Jamin Pelkey, Sari Park, and Stéphanie Walsh Matthews, *Testing Symmetrical Knot Tracing for Cognitive Priming Effects Rules out Analytic Analogy*, *Symmetry*, 13, 2021, 1):

> Ritual knots are symmetrical crisscrossing designs that appear in distant cultures around the world. Their independent emergence is plausibly due to shared features of human cognition and experience that such patterns represent. Since empirical investigation of this possibility is lacking in the literature, our aim is to open up this research area. We do so by asking whether the cultural production and appreciation of ritual knots could be conditioned or motivated by alignments and affordances linked to creative human cognition -- advanced analogical modeling processes that are themselves often discussed in terms of bidirectional blending and symmetrical mapping... the research opens the way for further empirical experimentation on the nature and emergence of symmetrical knots and their potential relationships with patterns of human thought.

The widely experienced process of knotting is closely related to that of stitching (*List of sewing stitches*, *Wikipedia*; Marc Jacobs, *12 Types of Hand Sewing Stitches*, *MasterClass*, 8 November 2020). Considerable effort has however been devoted to the possibility of a formal classification of knots -- as yet to be conclusively achieved.

Table of all prime knots with up to seven crossings represented as knot diagrams with their medial graph.

Unknot, 3_1, 4_1, 5_1, 5_2, 6_1, 6_2, 6_3, 7_1, 7_2, 7_3, 7_4, 7_5, 7_6, 7_7

User:Jkasd and User:Christian.Mercat, Public domain, via Wikimedia Commons

With respect to the organization of cognitive processes implied by prefixes, as argued here, there is then the possibility that there is a degree of correspondence between a fundamental set of prefixes and the basic "knot moves" or "knot operations" by which a knot is formed, as determined by the mathematics of knot theory. These include:

- the flype, namely to fold or turn back
- the Habiro move,
- Markov moves: conjugation, stabilization
- the pass move,
- the Perko move, and
- the Reidemeister moves: twist, poke, and slide move

Double binds and incompatible knots: The relation between knots and cognitive processes has been a concern to psychiatrists, notably Jacques Lacan ((*From the Bridges of Königsberg: why topology matters in psychoanalysis*, *LacanOnline*, 2015; Jean Michel Vappereau.,*Knot: the theory of the knot outlined by Jacques Lacan*, *Lacanian Works*, July 1996;). It has been extensively explored by R. D. Laing (*Knots*, 1970). A movie (1975) based on that book explores the common psychological knots and hang ups that make human communication much harder than it needs to be. The *Wikipedia* profile features Laing perusing *The Ashley Book of Knots* (1944).

Laing expanded the view of the "double bind" hypothesis put forth by Gregory Bateson and his colleagues, formulating a new concept to describe the highly complex situation that unfolds in the process of "going mad", namely an "incompatible knot". The implications have been explored in relation to addiction by Guy du Plessis ('*Incompatible knots' in harm reduction: a philosophical analysis*, *PhilArchive*, 2019). Laing compared this knot to a situation where your right hand can exist but your left hand cannot. Without denying the existence of mental illness, Laing viewed it in a radically different light from his contemporaries. For him, mental illness could be a transformative episode whereby the process of undergoing mental distress was compared to a shamanic journey.

Double binds are often utilized as a form of control without open coercion -- the use of confusion makes them difficult both to respond to and to resist. A double bind generally includes different levels of abstraction in the order of messages and these messages can either be stated explicitly or implicitly within the context of the situation, or they can be conveyed by tone of voice or body language. Further complications arise when frequent double binds are part of an ongoing relationship to which the person or group is committed.

With referring to the psychiatric perspective. a knot-model of the human mind has been proposed by Akio Kawauchi (*A Knot Model in Psychology*, July 2010):

> By evaluating the five factors in the five-factor model of personality established by Eysenck-Eysenck and Costa-McCrae, we construct a knot model of a human mind in terms of 2-bridge knots so that the knot type of a mind-knot gives the personality. We relate the classification of the self-releasability relations of mind-links to a certain classification of links. The (normal) self-releasability relations for two mind-knots and three mind-knots are classified into 3 relations and 30 relations, respectively.

Knitting: The process of knotting and knitting are clearly related although any theory of knitting would tend to be subsumed by academic preoccupation with the theory of knots. It is therefore somewhat surprising that widespread familiarity with knitting has engendered an extensive literature on the psychology of knitting:

- Züleyha degirmenci: *Positive Effects of Hand Knitting on the Psychology of People* (49th IFKT International Congress "Stepping into the future…", Lodz, 2018)
- Temma Ehrenfeld: *Knitting Is Good For You* (*Psychology Today*, 2 June 2015)
- Jill Riley, et al: *The Benefits of Knitting for Personal and Social Wellbeing in Adulthood: findings from an international survey*, *British Journal of Occupational Therapy*, 15 February 2013)
- *The Mental Health Benefits of Knitting* (*Mental Health America*, 21 January 2019)

There is indeed recognition of the variety of stitches employed in knitting (*List of knitting stitches*, *Wikipedia*; Soumyadeep Saha, *Stitch Classification: various types stitches used in garment making*, *CCS*, 27 May 2020).
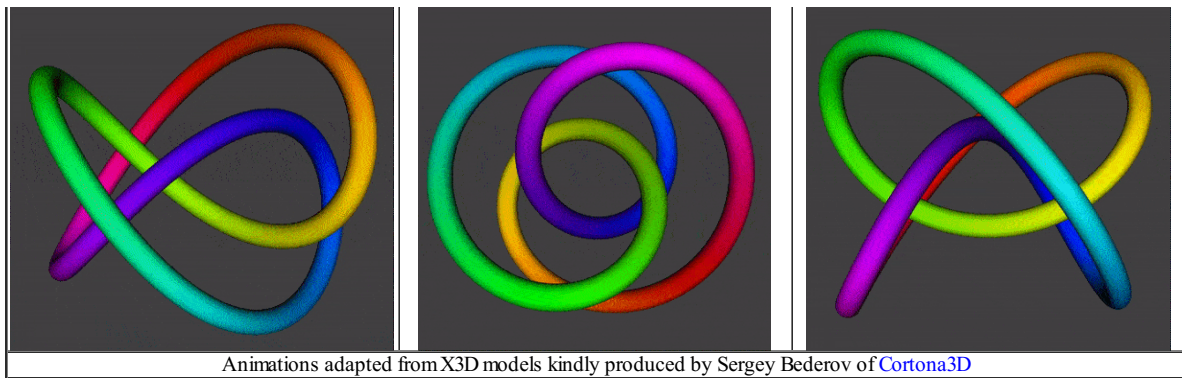
However, as with knots, there is relatively little concern with the distinct cognitive processes with which different stitches might be associated. This is despite recognition of the overlapping of knitting and neuroscience, as reported by Ian Hickie and Jackie Randles (*Knitting your way to a healthier, happier mind*, *The Conversation*, 11 September 2015). Cultivating that relationship, the authors note the extensive development of Neural Knitwork communities (*Neural Knitworks: craft a healthy brain*).

In contrast to the problematic connotation of knots (metaphorically understood), more intriguing in relation to the argument here is reference to the integrative function associated with an understanding of knitting (Sebastian Lemire, *What is This Thing Called Theory Knitting? American Evaluation Association*, 15 December 2019; David A. Kalmar and Robert J. Sternberg, *Theory Knitting: an integrative approach to theory development*, *Philosophical Psychology*, 1, 1988, 2). The authors of the latter note:

> A close scrutiny of the psychological literature reveals that many psychologists favor a 'segregative' approach to theory development. One theory is pitted against another, and the one that accounts for the data most successfully is deemed the theory of choice. However, an examination of the theoretical debates in which the segregative approach has been pursued reveals a variety of weaknesses to the approach, namely, masking an underlying theoretical indistinguishability of theoretical predictions, causing psychologists to focus unknowingly on different aspects of the same phenomenon, and locking the theorist into a particular way of looking at a phenomenon.... Work on intentionality and constructionism by philosophers of mind suggests an alternative to the segregative approach to theory development. We call this alternative the 'integrative' approach. In this approach one integrates the best aspects of a set of given theories with one's own ideas regarding the domain under investigation. Instead of emphasising those features that discriminate among theories, this approach seeks to identify those facets of competing theories that can provide a unified explanation of a given problem area.

Minimal knot of requisite complexity? If a knot or juggling pattern could be understood as "holding" the requisite variety of cognitive operations for a viable system -- as implied by a configuration of prefixes -- there is a case for exploring a recently discovered knot which has been the focus of extensive attention. This is most succinctly presented by Louis Kauffman (*Pattern, Sign and Space: Mereon Thoughts*. University of Illinois at Chicago, 2003). Otherwise known and visualized as the Mereon Matrix and the Mereon Trefoil, its potential significance is elaborated in a far more extensive work (Louis H Kauffman, et al, *The Mereon Matrix: everything connected through (k)nothing*, 2018; frontmatter) to which detailed reference is made in the conclusion of a related exploration (*Identifying Polyhedra Enabling Memorable Strategic Mapping*, 2020).

The parameters by which the knot can be visualized are seemingly not readily available. The following visualizations as 3D animations were kindly produced by Sergey Bederov for the purpose of this exercise using parameters: x= cos(t*3)*2+cos(t); y= -sin(t)-sin(t*3)*2; z= -sin(t*2)*3.

Animations offering contrasting perspectives on the Mereon Trefoil pattern

Animations adapted from X3D models kindly produced by Sergey Bederov of Cortona3D

Cognitive embodiment? Perhaps necessarily elusive is any understanding of the cognitive correspondences between the indications presented above with respect to prefixes, oppositional logic, Thom's morphological types, knots, juggling patterns, and Young's 12-fold articulation -- as might be reframed in terms of 8-foldness, 12-foldness, or N-foldness.

It could well be asked whether the improbability of any such correspondence, and the necessarily disparate nature, is somewhat similar to that famously caricatured as "mathematical moonshine" (Brandon Rayhaun, *The Story of Moonshine: symmetry, number theory, and the monster*, 2015). This gave rise to the discovery of the so-called Monster Group, as discussed separately (*Potential Psychosocial Significance of Monstrous Moonshine: an exceptional form of symmetry as a Rosetta stone for cognitive frameworks*, 2007).

The challenge is all the greater when confronted with the combination of simplicity-complexity and comprehensibility-incomprehensibility of the Mereon pattern above. If the array of fundamental cognitive functions is held by some such configuration, how are they embodied together as a dynamic -- as a sustainable "viable system"?

Whilst the Mereon pattern tends to be presented statically, as is typical of knots, its relevance and value for cognitive processes may lie in a dynamic, as tentatively suggested by the animations above -- and by knotting and juggling. Of interest then would be any reconciliation between the static nature of polyhedral patterns (indicated above as mappings) with a rotation of the Mereon pattern.

One visualization consistent with such an exploration is the non-alternating weave of the curve on the surface of a rhombic triacontahedron as variously presented by Robert Gray (*Lynnclaire Dennis' Geometry: The Pattern*). It is reproduced by Kauffman (2003). This could be seen as a step towards representations of the cognitive dynamics which are only implied by the work of Buckminster Fuller (R. W. Gray, *Lynnclaire Dennis and R. Buckminster Fuller Investigation*, In: Kauffman, et al., 2018). As Gray notes with respect to the elaboration of the Mereon Trefoil as a matrix:

> Specifically, Dennis' matrix includes at least 10 Tetrahedra, 5 Cubes, 5 Octahedra, 5 Cube-Octahedra (Fuller's "Vector Equilibrium"), 5 Rhombic Dodecahedra, 1 regular Dodecahedron, 5 Icosahedron and 1 Rhombic Triacontahedron. Fuller's matrix of polyhedra does not accommodate all these polyhedra into a single matrix...
>
> As a further result of these investigations, it was discovered that the "Jitterbug" motion [of the Vector Equilibrium] that Dennis describes, not only includes the Tetrahedron, Octahedron, Icosahedron and the Cube-Octahedron positions but also includes a position in which the Cube and the regular Dodecahedron are defined. This, a result that Fuller does not seem to have recognised has resulted in the formal mathematics describing how the complete Jitterbug motion is found to follow elliptical paths defined by 4 intersecting cylinders... (pp. xxix-xxxiii).
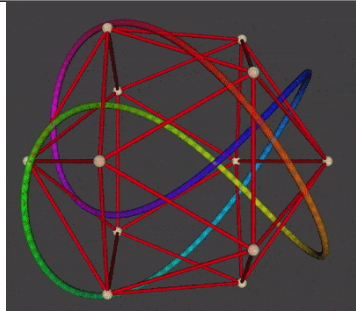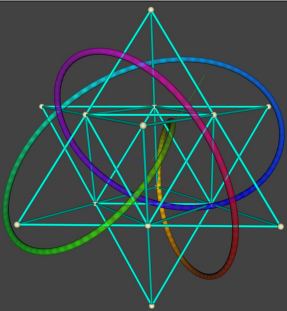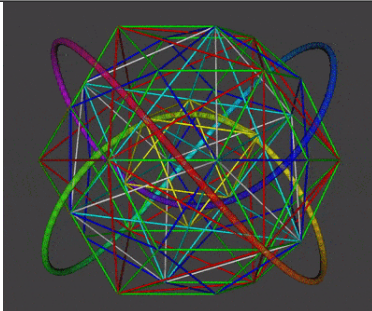
Gray presents different views of the Mereon Trefoil on the faces of a tetrahedron, as defined by 2 intersecting helices, and as involuting-evoluting on a torus. He includes images showing how rotation of selected polyhedra defines the trefoil pattern. With the focus here on embodiment, Gray paraphrases Fuller to the effect that: ***You are not the knot. You are the pattern integrity defined by the knot***.

Exploratory rotation of the Mereon Trefoil in relation to polyhedra: Rather than rotating any polyhedron, consideration can be given to the possibility of rotating the Mereon knot as implying a cognitive **dynamic** in relation to the simplest Platonic polyhedra with their typically **static** emphasis as implied by any associated cognitive dynamic (notably in sacred geometry).

- A first exercise is with respect to the icosahedron (below left). As noted by Sergey Bederov (personal communication), the periodic passing of the curve through vertices of various polyhedra is a consequence of the polyhedral symmetry and does not have any connection to the specific curve equations. In the case of the icosahedron, the latter is positioned with two vertices on the axis of rotation of the curve. The remaining 10 vertices of the icosahedron are located on two circles orthogonal to that line. When the scale of the curve is adjusted so that it intersects with one of the circles, it therefore follows that, when the curve is rotated around that axis, this point always remains on the circle and passes through all five icosahedral vertices. The curve itself also has some degree of symmetry, therefore it also intersects the second circle -- and intersecting each circle twice -- so the passes are occuring alternately on different sides of the circle and alternately on different circles. The curve -- rotating on an axis through 2 of the 12 vertices -- therefore passes periodically through 10 of the 12 vertices.

  The connectivity between selected vertices, as dynamically established by the rotation, can then be usefully understood as a form of switching mechanism between distinctive cognitive functions -- a complete set resulting from the cycle of rotation. **Of particular interest however is the relation between the polyhedral axis of symmetry and that of the rotating curve** -- given that different axes might have been used for the rotation.

- A second exercise helps to clarify the issue using a double tetrahedron whose 8 vertices frame a cube (as illustrated above). As indicated by Sergey Bederov, this is positioned in an asymmetric way in the animation (below centre). Although the centre of the structure is still at the origin (and each vertex has a centrally symmetric companion), due to the symmetry of the curve, it passes through two opposite vertices as it rotates (albeit at different moments of time). However the axis of rotation does not coincide with any symmetry axis of the tetrahedral structure, therefore the curve does not pass through any of the other vertices. The animation can be considered an instructive failure in illustrating the limited (cognitive) connectivity resulting from misalignment of the static and dynamic forms.

- In a third exercise the exploration can be taken further in the light of the seminal schematic of the cosmos by Johannes Kelpler (*Mysterium Cosmographicum*, 1597) whereby the Platonic polyhedra were nested within one another. A 3D variant in which these are embedded within a rhombic triacontahedron is discussed separately, with various animations (*Nesting polyhedra to enable comparison of patterns of discourse*, 2015). The 3D dynamic variant (below right) offers a unique embedding of the Platonic polyhedra: dodecahedron (blue), icosahedron (red), cube (white), octahedron (yellow), with 2 tetrahedra (cyan). Justification for use of the rhombic triacontahedron is presented in the earlier exercise. Especially noteworthy there are the distinctive implications of mutual rotation and a "pumping" action resulting from relative changes of scale of the nested polyhedra.

Rotation of Mereon Trefoil in relation to Platonic polyhedra (with the central image indicating axial misalignment)		
Icosahedron with Mereon Trefoil	Tetrahedron-2 with Mereon Trefoil	Nested Platonic polyhedra with Mereon Trefoil
Animations adapted from X3D models kindly produced by Sergey Bederov of Cortona3D		

In the exercise with nested polyhedra (above right), the orientation used was that of the icosahedral exercise (above left) with the result that the curve passes periodically through 10 of the 12 vertices of the icosahedron (in red), but not through the framing rhombic triacontrahedron (in green). Further exploration is required to determine whether in fact it passes through the vertices of the other Platonic polyhedra. Various animation techniques could be explored to make the animation on the right more comprehensible.

With the vertices of the icosahedral associated with distinctive cognitive functions, the rotation of the Mereon Trefoil around axial pair of vertices suggests a further possibility. It could then be hypothesized (in terms of its potential cognitive significance) that the curve does not only rotate around one axis of a polyhedron but may shift between the set of axes of a polyhedron -- changes in "orientation" in ways to be explored. This recalls issues relating to shifts in the Earth's geomagnetic field, most dramatically in the form of geomagnetic reversal. It usefully frames questions with regard to the polarization of cognitive dynamics -- so unfortunately characteristic of psychosocial systems (as noted above). How might the drift, or shift, between different axes then be recognized?

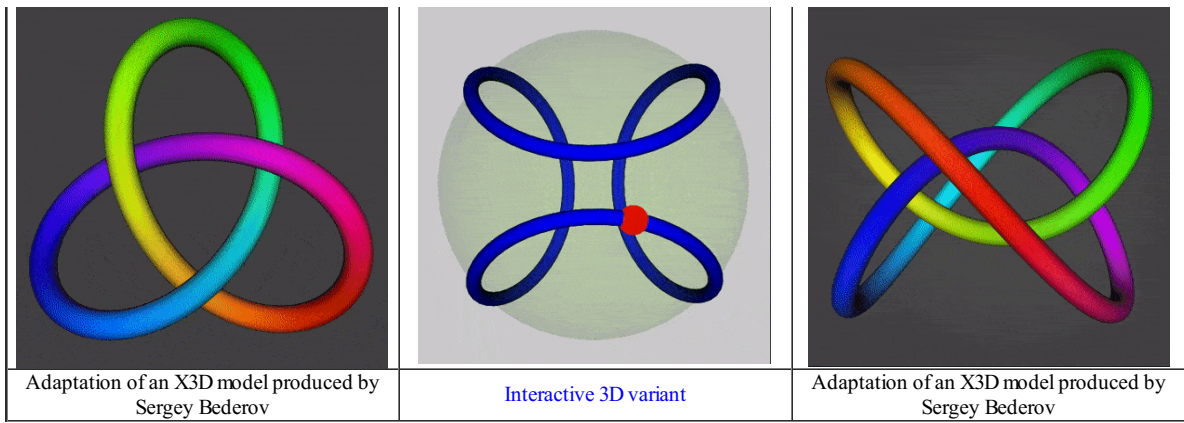## Globalization: playing ball, self-reflexivity and self-penetration?

The spherically symmetrical polyhedra to which is reference is made above correspond to different degrees of approximation to a sphere -- to the globe which features so prominently in discourse about globalization. As an integrative concept and symbol its implications are a challenge to cognitive engagement.

One approach is through recognition that its subtle complexity is reflected in a strange manner in the design of balls used in ball games world wide. The stitching pattern on the association football offers one example -- given that this takes the form of a truncated icosahedron (*Understanding Sustainable Dialogue: the secret within Bucky's Ball?* 1996). Another example is offered by the baseball / tennis ball curve discussed below.

Why would a global civilization associate the fundamental symbolic value of integration (and "unity") with the process of striking a ball competitively?

Baseball curve / Tennis ball curve: Whilst the form of the Mereon Trefoil is somewhat difficult to remember, its visual complexification is evident to a degree in the transition from the simple trefoil knot (below left) through the curve which is a prominent feature of the seam of every tennis ball and baseball (below centre). Both the trefoil knot and the 2D image of the baseball curve are a feature of traditional Celtic knots.

Comparable animations englobing a sphere?		
Trefoil knot	Baseball / Tennis ball seam curve	Mereon Trefoil

Adaptation of an X3D model produced by Sergey Bederov	Interactive 3D variant	Adaptation of an X3D model produced by Sergey Bederov

The parameters by which the three can be visualized could be explored as related, although the point is made that variants have been proposed for the baseball curve (Dean Allison, Ricardo Diaz, and Nathaniel Miller, *Generalized Baseball Curves: Three Symmetries and You're In! Loci, MAA Mathematical Sciences Digital Library,* September 2008, 2866). It is discussed by Robert Ferréol (*Bicylindrical Curve*, 2018) as the intersections between **two** cylinders of revolution, otherwise known as a Steinmetz curve. The complete Jitterbug dynamic, with which the Mereon Trefoil has been associated (as noted above), can be defined mathematically as following elliptical paths defined by **four** intersecting cylinders.

The dynamics associated with the tennis ball/basketball curve are discussed and illustrated separately, notably in relation to the form of a baseball cap (*Non-linear pathways curving between octants*, 2020; *Systemic and cognitive implications of baseball cap framing?* 2020). An interactive 3D model is presented allowing users to modify the parameters of the baseball curve (designed by Sergey Bederov of Cortona 3D) -- in the context of speculation on *Negligence of a "global wave" from a "wavelet" perspective?* (2020).

In his above-mentioned discussion of the Mereon Trefoil, Louis Kauffaman (2003) presents a valuable illustrated discussion of the traditional Chinese *Wu Xing* pattern of 5 elements, in a section titled (*From The Five Elements to the Petersen Graph and the Dodecahedron*). In a separate discussion on the cognitive challenges of proximity in relation local versus global, a concluding section argued that the linking lines in the Wu Xing pattern (left, upper) could each be more appropriately represented as a torus (*Imagining a mnemonic device of requisite higher dimensionality*, 2019). The animation of a 3D model (left, below) offers an indication of this.

However, in the light of the use above of a sphere to indicate degrees of comprehension, variations in systemic (in)comprehensibility of the disparate elements of the *Wu Xing* pattern are indicated in the other animations below -- in each case with wireframe alternates to indicate what is hidden.
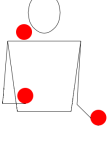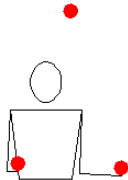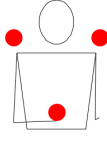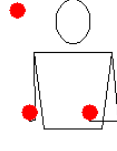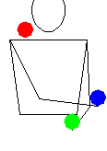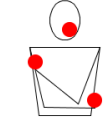
Degrees of comprehension of 5-phase *Wu Xing* cycle experimentally depicted as a configuration of tori in 3D (Animations of spheres moving through tori as systemic links)			
Wu Xing pattern in 2D and 3D	Minimal systemic comprehension	Conventional systemic comprehension	Partial in-depth comprehension

Virtual reality variants: x3d, wrl. Video variants: mp4 (left)
Other design parameters could be used for diameter/colour/speed of spheres, and direction/speed of rotation
Transparency could be variously changed. Spheres could be replaced by distinctive Platonic polyhedra

Juggling: Curiously juggling could be recognized as a non-competitive form of playing with a ball -- with the challenge being the competence of the juggler. Given the archetypal challenge of the Gordian Knot, the complementary cognitive relevance of knotting and juggling merits consideration (*Mapping grossness: Gordian knot of governance as a Discordian mandala?* 2016; *Governance as "juggling" -- Juggling as "governance": dynamics of braiding incommensurable insights for sustainable governance*, 2018). The latter concluded with discussions of:

- Determining the requisite number of patterns, partners and "balls" in governance

- Acquiring a "sense" of 12 modalities for viable system awareness?

Related correspondences might be usefully recognized in the movements associated with juggling, as variously clarified (Burkard Polster, *The Mathematics of Juggling*, 2003; Jochen Voss, *The Mathematical Theory of Juggling*, 2012; Jarold Jacob Tawney, *Jugglinks: Tangling Together the Worlds of Knot Theory and Juggling*, Ohio State University, 2001).

Selection of animations of 3-ball juggling patterns by one juggler (derived from juggling patterns in *Wikipedia*)					
3-ball cascade	3-ball shower	3-ball columns	3-ball box	3-ball Mills mess	3-ball Burke's barrage
attribution	attribution	attribution	attribution	attribution	attribution

Self-reference and self-reflexivity: Juggling necessarily gives immediate insight to the juggler with regard to what current competence enables with respect to what is juggled -- sustainably. It could be described as the art of the possible in the light of recognition of limitations. This is far less evident in the case of knotting, whatever the degree of correspondence between juggling and knotting.

Sustaining the juggling process can be explored in the light of the different orders of feedback understood in cybernetic terms with respect to the operation of a viable system, as discussed separately (***). This has notably been articulated by Maurice Yolles (*Knowledge Cybernetics: a metaphor for post-normal science*, 2009; *Organisations as Complex Systems: an introduction to knowledge cybernetics*, 2006).

Whether in cognitive terms, or with regard to the challenge of a global civilization, competence in regard to self-reference is clearly problematic (Hilary Lawson, *Reflexivity: the post-modern predicament*, 1986; George Lakoff and Mark Johnson, *Philosophy in the Flesh: the embodied mind and its challenge to western thought*, 1999; Nassim Nicholas Taleb, *Skin in the Game: hidden asymmetries in daily life*, 2018). Framed by prefixes, it is the challenge of "intro-" (as in introspection), or of "sub-" -- namely subjectivity in contrast to objectivity.

There is however a case for using the embedding of symmetrical knots in a sphere (as above) as a means of representing the challenge visually. The animations variously show the relation of knot-like forms to a sphere. Even though the knots have a degree of symmetry in spherical terms, it is however clear that their relation to any "global" comprehension is problematic -- if the knot is to be understood as "grasping" and "holding" that form.

Superficiality: It is in this sense that the baseball curve appears most successful in containing the sphere. It achieves this by being essentially -- and elegantly -- superficial. It does not penetrate the sphere in any way, although it may appear to do so when the sphere is transparent. This is not the case with the trefoil knots. Each clearly penetrates and traverses the sphere, potentially implying greater cognitive depth and integration -- and a degree of requisite cognitive twist appropriate to any visualization of self-reference.

It can be readily argued that global civilization is "superficial" -- as it is widely understood and presented -- and becoming more so through a variety of processes usefully framed as "dumbing down". This is despite the fact that the dynamics of the ball games played globally imply an integrative depth to which allusion can only be made in passing through reference to the "spirit of the game". In that light civilization is essentially unconscious and simplistic in any claims to vital self-referential cognitive dynamics, as argued by John Ralston Saul (*Unconscious Civilization*, 1995). This could be understood as implied by the intuitive credibility accorded to conspiracy theories and hidden agendas (*Inspiration, Conspiration, Transpiration, Expiration: towards a universal model of conspiracy theories*, 2020).

Much is necessarily "unsaid:, as may be variously argued (*Global Strategic Implications of the "Unsaid"*, 2003; *Varieties of Tone of Voice and Engagement with Global Strategy*, 2020). It is readily recognized that much occurs in an "underhand manner", "under the belt", "under the table", or "under the radar". Conventional models readily discount the potential consequences of such dynamics -- despite their significant consequences.

Penetration and invagination: In the animations of the two trefoil knots above, the curves are shown as "penetrating" the surface of the sphere (in its non-transparent phase) -- in contrast to the baseball curve, where this is not the case.

Given the fundamental role of penetration as it relates to sexual intercourse, it is appropriate to explore the relevance of that metaphor -- understood as a prelude to engendering renewal, variously anticipated as a global Renaissance (*Challenges of Renaissance: suggestive pattern of concerns in the light of the birth metaphor*, 2003). No "penetration"; no "Renaissance"? In biological terms the intermediary processes are invagination and gastrulation -- inviting speculative reflection on their systemic implications:

- *Invagination in psychosocial terms: understandings from web resources* (2010)
- *Engendering Invagination and Gastrulation of Globalization* (2010)
- *Complexification of Globalization and Toroidal Transformation: topological implications of invagination and gastrulation in embryogenesis* (2010)

Violation, expletives, piercings, self-harm and inoculation: The future may recognize as extraordinary the degree to which the cognitive process of "penetration" and self-reference is now celebrated and cultivated "superficially" -- a process of pseudophilia:

- *Violence*: The current extent of violence, and anticipation of violence on a global scale, requires no comment. Violence in the media

is now a fundamental requirement for entertainment. In order to be attractive (and marketable) such products tend to acquire credibility through a marked degree of violence. For example, those watching television are typically exposed to a daily diet of murders -- in addition to beatings, if not torture, rehearsed in much online gaming. This pattern curiously echoes what is deprecated as uncivilized in the Roman Empire of the past with its focus on violent games and gladiatorial combat. Entertainment echoes and celebrates the violence symbolized by missiles and their global trajectories.

- **Rape**: As a particular form of violence, the widespread incidence of individual rape calls for no comment. Curiously an analogous phenomenon has been recognized with respect to the rape of countries by other countries and institutions (Heather Cottin, *The IMF rapes the world*, *Workers World*, 7 July 2011; Matthew Rothschild, *The IMF Chief's Rape Charge: metaphor for the IMF's abuse of power*, *Common Dreams*, 16 May 2011).

- **Self-harm and suicide**: The pattern of violence and violation is now self-focused as indicated by the increase in self-harm, potentially taking an ultimate form in suicide. This frames the question as to whether countries -- and global civilization -- are now subscribing to this pattern, especially with the anticipation of civilizational collapse (*Mind Map of Global Civilizational Collapse: why nothing is happening in response to global challenges*, 2011).

- **Expletives**: The authenticity of discourse is increasingly indicated by use of "fuck", most obviously in popular films, seemingly as a reflection of discourse in the real world among real people. This contrasts with depiction of worlds -- "bubbles" -- in which no such reference is made, and in carefully censored formal discourse. As argued separately, strategies are elaborated and negotiated in contexts in which such expletives are characteristic -- only to be presented publicly through edited versions increasingly lacking any credibility (*Mysterious Complementarity between Capitalism and Arsenalism: metaphors crucial to sustainability and the crisis of the times*, 2020). Is the meaningful communication of significance possible without an implication of penetration? Most curious with respect to any intuitive call for self-reference is the common injunction "*go fuck yourself*" -- curious given the physical impossibility.

- **Piercings**: Arguably the fashionable appeal of body piercing as a distinguishing mark of identity and individuality can be recognized as symbolizing and embodying penetration -- and the authenticity it is held to imply (*List of body piercings*, *Wikipedia*).

- **Inoculation**: Current moves towards mandatory universal vaccination (in response to the COVID pandemic) merit recognition as a feature of the pattern highlighted by the previous points. They could be understood as a radically revised implementation of the essentially failed ambition towards universal indoctrination by the major ideologies and religions of the world.

The manner in which the curves of the trefoil knots dip beneath the surface of the associated sphere (in the animations above) -- seemingly to separate portions of the continuing curve -- merits recognition as echoing the strange interaction between a conscious objective world and an unconscious netherworld. As an underworld of subjectivity, this may be variously explored (*Designing Global Self-governance for the Future: patterns of dynamic integration of the netherworld*, 2010; *Engaging with the Future with Insights of the Past*, 2010). As the latter notes, interaction with the "underworld" has been of major importance in civilizations of the past. For the current global civilization, any such problematic preoccupation is primarily with regard to the underworld of organized crime.

The intuited reality, hidden below the surface of the sphere of conventional discourse, is most obviously experienced in terms of the widespread incidence of mood depression -- and the triggers this offers for the phenomena above. The irony is all the greater in the degree of correspondence with economic depression. The separateness indicated by the dipping of the curves below that surface is also curiously echoed by the attitude to otherness and especially to waste disposal (*Unrecycled waste disposal as evidence for Planet Earth as a "shithole"*, 2018). Indifference to the world, as implied by the common corporate expletive "*fuck the world*", has the curious reactive consequence that the world will "*fuck you back*" in systemic terms.

It is in this context that the world is faced with the anticipation of a Great Reset -- a simplification by elites in highly controversial contrast to past dreams of a new Renaissance (Klaus Schwab and Thierry Malleret, *COVID-19: the Great Reset*, *World Economic Forum*, 2020). Missing is any understanding of how integration of any evoked "controversy" is fundamental to the paradoxical nature of the requisite cognitive twist in systemic terms, as discussed above (*Missing "halves" of the Global Reset mandalas?* 2020). How will the "netherworld" respond?

Quest for sustainability as an infinite game?

There is no lack of appreciation that game-playing offers an insightful metaphor into the dynamics of the current condition -- especially as characterized by blame games (*Institutional Games and Strategies as a Response to Complexity*, 1977; *Collective Mea Culpa? You Must be Joking!* 2015; Susan Krauss Whitbourne, *5 Reasons We Play the Blame Game*, *Psychology Today*, 19 September 2015). It invites recognition as a complement to more conventional focus on the "global problematique" -- namely as a "global ludique". Given how the future might then be imagined, a fourfold complement with a "global resolutique" and a "global imaginatique", is discussed separately (*Interrelating problematique and resolutique in terms of "real" and "imaginary"*, 2007).

It is then appropriate to ask how game-playing is integrated into any understanding of the sustainability to which so many strategies purport to aspire. More to the point, to what extent is the Great Reset of the World Economic Forum to be construed as a move in a game -- effectively played with the World Social Forum (*All Blacks of Davos vs All Greens of Porto Alegre: reframing global strategic discord through polyphony?* 2007). Is sustainability to be understood as a new framing of the so-called "Great Game" (*Playing the Great Game with Intelligence: authority versus the people*, 2013)?

The global dynamic implied by the Mereon Trefoil, as a neverending knot, could then be understood as indicative of the kind of

"neverending story" implied by the argument for infinite games (James P. Carse, *Finite and Infinite Games: a vision of life as play and possibility*, 1986; Simon Sinek, *The Infinite Game*, 2019). These share the inspiration of *The Glass Bead Game* (1943) articulated by Hermann Hesse, as discussed separately (*Evoking Castalia as Envisaged, Entoned and Embodied: the great game informed by the bertsolaritza cultural process?* 2016).

The various indications above of formal structures as a guide to comprehension of "unity" -- most obviously polyhedra and knots -- necessarily detract from the experiential engagement with unity, ignored by the mathematicians who explore them. This highlights a paradox between the constraint of structure on that experience -- fundamental to the implication of Biden's aspiration to a unity challenged to a high degree by dissent. Arguably the unity defined and framed by structure in ideologies and governance, inihibits the high degree of cognitive freedom implied by unity -- most allusively indicated in Daoism. Helpful in this respect is the argument of David Bohm with respect to the contrast between the "explicate order" of structural articulation and the "implicate order" of compactified experience (*Wholeness and the Implicate Order*, 1980). Bohm suggests an alternating process of "holomovement" between them.

Arguably some sense of this process is evident from the capacity to engage in different games rather than in any one game -- namely to shift among an array of distinctive games offering complementary insights. These could also be understood as "worlds" (as in world-making) or "bubbles" (as in current jargon). **Unity is therefore associated with a dynamic in some fundamental manner, rather than as so questionably framed by leaders** (*Living as an Imaginal Bridge between Worlds: global implications of "betwixt and between" and liminality*, 2011; *Embodying Values Dynamically through Alternation*, 2008). It is metaphors that offer the most comprehensible access to radically incommensurable alternatives (*Metaphors of Alternation: an exploration of their significance for development policy-making*, 1984). They suggest a means of reframing the staggering inconsistencies by which global governance is currently characterized.

The argument can be taken further through the association of play with music and recreation, especially given the ease with which the human brain can engage to a remarkable degree with complexity through music. With the future of global civilization now imagined to be informed by a so-called "global brain", there is an appropriate elegance to recognition that its organization and operation may require that it be effectively played (*Envisaging a Comprehensible Global Brain -- as a Playful Organ*, 2019). This recalls the imagined paradoxical challenge of navigating a space-time vessel in process of construction (M. A. Foster, *The Game Players of Zan*, 1977).

With respect to any understanding of integrartive unity, the *(Updated) Last Whole Earth Catalog* (1974) carried on its cover the phrase: *We can't put it together; it is together*. How then does one "put together" what "is together" -- even though one does not "know how" or "by whom" that is understood or enabled?

Understood as a quest by the players, the game in question may be fruitfully informed by the paradoxical insight of the journey of 30 distinctive birds across seven valleys in quest of the legendary Simorgh -- in the classic Sufi poem *The Conference of the Birds* (1177) by Farid ud-Din Attar. The 30-fold pattern offers associations to both the 30 pieces of silver (so symbolic of betrayal) and to the icosahedral configuration of distinctions (from a cybernetic perspective) by Stafford Beer (*Beyond Dispute*, 1994). In the end, the birds learn that they themselves are the Simorgh, as is embodied in the name in Persian: thirty (*si*) birds (*morgh*). This self-reflexive mirroring is echoed in the insight of a Western poet T. S. Eliot:

> We shall not cease from exploration,
> And the end of all our exploring
> Will be to arrive where we started
> And know it for the first time.
> (*Little Gidding*, 1942).

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