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## Metascience Enabling Upgrades to the Scientific Process

### Beyond Science 2.0 in the light of polyhedral metaphors?

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## Introduction

There is a sense in which the methodology of science is held to be "written in stone" -- and believed justifiably to be so -- as with revealed religion before it. As noted separately in the [main paper](#), it exhibits few characteristics which bear comparison to the software upgrade process -- despite vigorous interest in the possibility of [open science](#), occasionally termed [Science 2.0](#). There is little question of annual "conceptware upgrades".

In the light of the argument in the main paper, the question is how to extend "science" from its narrow focus to one which encompasses what is implied by the term, namely a particular approach to knowing -- irrespective of the domain to which it may be applied. This therefore includes preoccupation with psychosocial intangibles whose very existence is so vigorously challenged by some forms of science.

Metascience is understood here as offering a key to engaging meaningfully with the [global problematique](#) via a [global resolutique](#) -- taking account of the marked dynamics of disagreement. To this end, and in order to achieve a coherent focus, a generic understanding is sought by separately conflating through metaphor each of the following three clusters:

- problem, question, challenge, threat, or provocative assertion
- resolution, answer, explanation, strategic response, shared agreement, or (unexamined) assumption
- disagreement, discord, inadequacy, incommensurability, incomprehensibility, or incompleteness.

Some possibilities to respond to this condition are indicated below. In particular, the clusters above are metaphorically associated with the primary characteristics of polyhedra as constituting metaphorical containers for coherence.

An initial question is what exactly is sought through a "metascience" perspective. What are the criteria, as tentatively scoped out in the past (*Criteria for an Adequate Meta-model*, 1971)? Various critics of the knowledge processes of science have formulated other criteria, as noted separately (*Knowledge Processes Neglected by Science: insights from the crisis of science and belief*, 2012). Other approaches to the matter include:

- [Unified science](#), as distinguished by *Wikipedia* in three approaches:
  - Belief in the [unity of science](#) as a central tenet of [logical positivism](#).
  - Quest for a common artificial language, partially inspired by the work of [Edward Haskell](#) (*Full Circle: the moral force of unified science*, 1972)
  - The focus on [systems ecology](#) of [Howard T. Odum](#)'s and the associated [Emergy Synthesis](#), modeling the Ecosystem by

developing a **common language of science** based on electronic schematics, with applications to ecology economic systems in mind (H. T. Odum, *Ecological and General Systems: an introduction to systems ecology*, 1994).

- **Integrative knowledge**, as variously understood through some 600 approaches profiled in the **Integrative Knowledge Project**. One commentary on its methodology offers a summary of *Previous, parallel or related initiatives*. This notes the efforts of **Erich Jantsch** (*Towards interdisciplinarity and transdisciplinarity in education and innovation*, 1972). Distinctions may be made, or blurred, between contrasting approaches endeavouring to reframe each other's understanding, as in:
  - The qualifier "integral", as in **integral thought**, is increasingly associated with the **integral theory** developed by **Ken Wilber**, as listed by *Wikipedia* (*List of integral thinkers and supporters*).
  - Use of **integrative thinking**, as articulated by Roger L. Martin (*The Opposable Mind: how successful leaders win through integrative thinking*, 2007).
  - **Integrative learning**, as a learning theory toward integrated lessons helping students make connections across curricula.
  - The significance of "integrative" has been more recently explored by **Jennifer Gidley** (*A Macrohistorical Planetary Tapestry: the fascinating integral narratives of Steiner, Gebser and Wilber*, 2007) as part of her exploration of *The Evolution of Consciousness as a Planetary Imperative* (2007).
- **Perennial philosophy** within the philosophy of religion viewing each of the world's religious traditions as sharing a single, universal truth on which the foundation of all religious knowledge and doctrine has grown.
- **Global brain**: As variously understood, following from the proposal of **H. G. Wells** for a collaboratively developed world encyclopedia, which he called a **World Brain**, and from the articulation by **Peter Russell** (*The Global Brain: speculations on the evolutionary leap to planetary consciousness*, 1982). A particular focus on quantum consciousness is developed by **Ervin Laszlo** (*Quantum Shift in the Global Brain: how the new scientific reality can change us and our world*, 2008). The various understandings have been reviewed by **Francis Heylighen** (*Conceptions of a Global Brain: an historical review*, 2011).
- **Systems sciences** and **complexity sciences**, most notably through the early inspiration and work of the founders of the **Society for General Systems Research**. These sciences have been much challenged to build fruitfully on that enterprise in relation to the needs of the times.
- **Transdisciplinarity** as through the focus of **Basarab Nicolescu** (*Manifesto of Transdisciplinarity*, 2002; *Transdisciplinarity: theory and practice*, 2008).
- **Symmetry**, as in the elaboration of classes of **symmetry group** of ever greater dimensionality, as discussed separately (*Potential Psychosocial Significance of Monstrous Moonshine: an exceptional form of symmetry as a Rosetta stone for cognitive frameworks*, 2007).
- **Metamathematics**, notably as presented by **Gregory Chaitin** (*Meta Maths: the quest for omega*, 2006)
- **Theory of Everything**, as the focus of fundamental physics. There is a sense in which further insight is to be derived via metaphor, as speculatively argued (*Everything as a Metaphorical Theory of Everything: not excluding nonsense, nothingness, the inexplicable, the irrelevant and their rejection*, 2012).

As a characteristic of the challenge of any metascience, in practice there is typically little love lost between the advocates of any of these approaches or their sympathizers (*Epistemological Challenge of Cognitive Body Odour: exploring the underside of dialogue*, 2006). Part of the challenge is then to factor in this dynamic and the cognitive styles it reflects (*Systems of Categories Distinguishing Cultural Biases*, 1993). Each approach, whether implicitly or explicitly, marginalizes and deprecates the others -- thereby excluding insights of some value, or valued by some. Each therefore acquires paradoxical significance through the questions it fails to ask -- a pattern with wider consequences for any form of governance (*Strategic Implications of 12 Unasked Questions in Response to Disaster*, 2013).

As argued in the main paper with respect to science, it is not so much the coherence that these integrative approaches offer that is of current global significance. Rather it is what they have been unable to recognize as most challenging to any fruitful integration. Like Science 1.0, through lack of self-reflexivity they are as much a part of the global problematique as of the global resolutique.

These approaches are challenged by the **incompleteness theorems** of **Kurt Gödel** with regard to mathematical logic. They establish inherent limitations of all but the most trivial axiomatic systems capable of doing arithmetic. Of greater significance to the argument here is however the lack of concern with humanity in these approaches to metascience. As with theological framing of the matter, they could be said to be inherently indifferent to suffering in practice, as argued separately (*Indifference to the Suffering of Others: occupying the moral and ethical high ground through doublespeak*, 2013). There is the further challenge of the human comprehensibility and communicability of the insights associated with any form of meta-model, as argued with respects to symmetry groups (*Dynamics of Symmetry Group Theorizing: comprehension of psycho-social implication*, 2008).

It is tragic that Science 1.0 should have learned so little from the religious pattern it aspires to replace. Yet many of the features of religion are only too evident in science as it is practiced. It is possible to recognize equivalents of: revelations, doctrines, (primarily male) priesthoods, acolytes, sanctuaries, condemnation of heresy, exclusivism, efforts to subsume the insights of others, and the sense of being specially chosen and uniquely mandated. The dilemmas are separately highlighted (*Self-reflexive Challenges of Integrative Futures*, 2008). Unfortunately the dysfunctionality is replicated in the more tangible practices of governance. In envisaging upgrades to science in the light of the software model, some thought could be given to the challenge of **"backward compatibility"** between Science 2.0, or 3.0, and Science 1.0 -- as well as those of any **legacy methodology**.

Given the "meta" quest common to both science and theology, and the inspiration of theology for some key mathematicians, consideration of the challenge of comprehension could be explored through "mathematical theology" (*Mathematical Theology -- Future Science of Confidence in Belief: self-reflexive global reframing to enable faith-based governance*, 2011). This is consistent with the framing of an **Omega Point** by **Pierre Teilhard de Chardin**, namely the idea of a maximum level of complexity and consciousness towards which the universe is evolving.

## Enhanced simulation of scientific processes

Many of the problematic functions noted in the [main paper](#) could be embodied in simulations -- going beyond the conventional, uncontroversial tangibles to include the intangibles and issues involving perceptions and beliefs, however "erroneous", from whatever perspective. Those could well include the unusual levels of arrogance exhibited amongst the icons of the scientific community -- especially in their exclusion of innovative perspectives. This is consistent with ensuring sensitivity to perceptions engendering social unrest, irrespective of their grounding in hard evidence -- explicitly those derived from what is readily defined as ignorance.

The possibility has been variously articulated (*Simulating a Global Brain -- using networks of international organizations, world problems, strategies, and values*, 2001; *World Dynamics and Psychodynamics: a step towards making abstract "world system" dynamic limitations meaningful to the individual*, 1971). Given the insights of cybernetics, particular consideration could be given to second and third order cybernetics, as previously argued (*Consciously Self-reflexive Global Initiatives: Renaissance zones, complex adaptive systems, and third order organizations*, 2007). With respect to reflexivity, a particular case for science to be attentive to the [third derivative](#) is made by [Arthur Young](#) (*The Third Derivative: errors and misconceptions of science*, 1990).

Science, but physics in particular, has made much of the deprecatory phrase "not even wrong". The problem is that much of science, as its evolution demonstrates, can be interpreted to indicate that science in the future may apply that phrase to the science of today -- in ways that are necessarily unforeseeable. This factor merits consideration in any simulation encompassing the emergence of new knowledge and new paradigms. Curiously, as recognized in a recent editorial, such a process is surprisingly inherent in the scientific method (*First, get it wrong*, *New Scientist*, 18 October 2013).

More fundamental is the technical challenge of how to build into a simulation the process of denial so characteristic of various forms of disagreement. The work of Ron Atkin on [q-analysis](#) is valuable in this respect (*Multidimensional Man: can man live in three dimensions?* 1981), as discussed separately (*Social organization determined by incommunicability of insights*; Jacky Legrand, *How far can Q-analysis go into social systems understanding?*).

## Topography of the challenge of humanity

A quite different approach is to seek methods of representation, most notably harnessing a geographical metaphor with which many are familiar. Mapping the internet has been seen as a possibility creatively undertaken through a variety of representational metaphors (see [Internet Mapping Project](#); Martin Vargic, *Map of the Internet 1.0: Explore this beautiful, hand-drawn map of the online world*)

Use can be made of features such as continents, mountain chains, valleys, rivers and the like to position different preoccupations distinctively with a comprehensible indication of their separation from each other and its probable consequences for communication (*The Territory Construed as the Map: in search of radical design innovations in the representation of human activities and their relationships*, 1979).

Unfortunately little attention has been given to the challenge of mapping the "world of knowledge", the noosphere, or the "universe of knowledge". The latter, especially in the light of the many maps of web traffic, suggests the possibility of a map inspired by astronomy (*Towards an Astrophysics of the Knowledge Universe: from astronautics to noonautics?* 2006).

More dynamic might be the use of the style of animation employed to indicate the shifting relationship between continental land masses over millions of years. The continents could then be associated with domains of knowledge and how they are linking and separating -- perhaps using tectonic plates as a metaphor (cf. Robert Davies, *The Shifting Tectonic Plates: facing new community challenges to business in a fragile world of risk and opportunity*, The Prince of Wales International Business Leaders Forum, 2002).

Even more dynamic might be to exploit the considerable (even daily) familiarity with meteorological and weather maps in order to represent movements of opinion and the associated high and low pressure zones (cyclones and anticyclones), especially as they might relate to collective suffering and problems more generally. Again the point should be made that it is this human dimension which needs to be fed into any fruitful mapping exercise -- offering points of engagement as is achieved to a degree with weather mapping.

In the quest for a more encompassing focus, the possibility of "mapping" may be dissociated from the topographical metaphor. There are of course many such mapping initiatives which endeavour to provide a sense of coherence and overview -- responsive to what is otherwise ignored by science (*Convergence of 30 Disabling Global Trends: mapping the social climate change engendering a perfect storm*, 2012; *Mapping the Global Underground: articulating Insightful Population Constraint Consideration (IPCC)* (2010); *Mind Map of Global Civilizational Collapse: why nothing is happening in response to global challenges*, 2011; *Map of Systemic Interdependencies None Dares Name: 12-fold challenge of global life and death*, 2011; *Mapping Paralysis and Tokenism in the Face of Potential Global Disaster: why nobody is about to do anything effective and what one might do about it*, 2011).

With respect to the thousands of entities profiled in the project of the above-mentioned *Encyclopedia of World Problems and Human Potential* ([commentary](#)) the approach may be taken further with the use of analytical software notably employed to track security challenges (*Preliminary NetMap Studies of Databases on Questions, World Problems, Global Strategies, and Values*, 2006).

## Reconsidering the imaginary unit (*i*) -- the "fudge factor" of science

It could be considered amazing that science, with its emphasis on evidential reality, should rely to such a degree on an [imaginary unit](#). As noted by Matthew Chalmers in reporting on the possibility that quantum theory might be rendered "real" through envisaging a "u-bit" (*From i to u: Searching for the quantum master bit*, *New Scientist*, 25 January 2014):

The square root of minus 1, also known as the imaginary unit, *i*, has been lurking in mathematics since the 16th century at

least... Since then, the imaginary unit and its offspring, two-dimensional "complex" numbers incorporating both real and imaginary elements, have wormed their way into many parts of mathematics, despite their lack of an obvious connection to the numbers we conventionally use to describe things around us. In geometry they appear in trigonometric equations, and in physics they provide a neat way to describe rotations and oscillations. Electrical engineers use them routinely in designing alternating-current circuits, and they are handy for describing light and sound waves, too.

The recent innovation by [Bill Wothers](#) is the possibility of replacing imaginary units by [real numbers](#), as noted by Chalmers. Real square roots would be comprehensible -- not a strange thing -- if nature is interested in a strong link between past and future. Wothers and his colleagues were able to replace [qubits](#) with real-number equivalents, and so capture all the weird correlations and uncertainties of conventional quantum theory "without an *i* in sight" ([arxiv.org/1210.4535](#), 2012). Chalmers continues:

A u-bit is a master bit: an entity that interacts with all other bits describing stuff in the universe... what it represents physically, no one.. can tell, but by entangling itself with everything in the universe, it is sufficient to replace every single complex number in quantum theory...But the u-bits influence might be felt indirectly. Since it interacts with everything in the universe, it can rough up even a supposedly isolated quantum system, making it "decohere" and lose its vital quantum properties in ways not predicted by standard quantum theory.

The imaginary unit figures most significantly in the so-called [Euler identity](#). This equation has been named as the "most beautiful theorem in mathematics" and has tied in a nomination by mathematicians for the "greatest equation ever" (Robert P. Crease, *The greatest equations ever*, *PhysicsWeb*, October 2004). As noted separately with respect to the experientially mysterious nature of living and dying (*Mathematical cosmology -- improving the inner game of dying*, 2013), the much quoted comment with reference to that identity is that of [Benjamin Peirce](#): *It is absolutely paradoxical; we cannot understand it, and we don't know what it means, but we have proved it, and therefore we know it must be the truth.*

Alternative conventional representations of the Euler identity	
$e^{i\pi} + 1 = 0$	$e$ is Euler's number, the base of natural logarithms,
$e^{i\pi} = -1$	$i$ is the imaginary unit, which satisfies $i^2 = -1$ , and $\pi$ is pi, the ratio of the circumference of a circle to its diameter.
Suggestive alternative representation of the "Euler identity"	
$1 \ddagger e^{i\pi} \ddagger 0$	More might be recognized by presenting the Euler relationship unconventionally through use of the double-dagger (for example), thereby suggesting that 1 and 0 are mediated in some way by a form of dynamic complexity.

Positioning the "complex" factor between 1 and 0 provides a variety of mnemonic clues to the relationship between the otherwise potentially simplistic understanding of what those extremes may denote in binary terms -- such as truth and falsehood, unity (or oneness) and nothingness. The mediating factor then governs the complex cognitive relationship between quantitative and qualitative with which imagination is so intimately associated. It usefully frames the complex experiential nature of dilemmas and the dynamics of the questioning process, with *e* suitably indicative of "either" in any decision-making consideration of options.

Understood as a "fudge factor" defying evidential reality in order to reconcile its elements, the *i*-element may then be usefully understood as any or all of a complex of such elements which are recognized in the experience of scientific endeavour -- but are excluded from any scientific explanation. These might include:

imaginary	interest	inspiration	intractable
insight	intuition	intelligence	incomprehensible
ignorance	instinct	intention	incompleteness
illusion	implication	integrative	indicative
inattention	incongruity	irresolution	ingenuity

In order for Science 1.0 to appear totally rational, it is necessary that imagination and related intangibles should be hidden where attention will not be readily drawn to them. This is the basis for the use of fudge factors in other domains. The artificial delimitation of the boundaries between the disciplines is indicative that all is not as well with science as is conventionally claimed

Given the proposal by Wothers, to "make quantum theory real" (really !?), such an array could be consistent with the spirit of the non-scientific comment on it by [Benjamin Schumacher](#) (as cited by Chalmers):

I think a good paper in fundamental physics shares some characteristics with a good joke: it has an unexpected take on a familiar idea, and yet in retrospect is has a certain screwball inevitability. By that standard, Bill's u-bit theory is a very good joke.

In the same mode, the physicist [Freeman John Dyson](#) has argued that: *It is characteristic of all deep human problems that they are not to be approached without some humor and some bewilderment.*

Especially useful is the sense in which widespread psychosocial aspirations to the simplicity of "oneness" and unity -- in contrast to the nothingness with which many are confronted -- is better and more challengingly understood within the Euler identity in terms of the root of "minus one". This counterintuitive operation might be applied to any of the **i-elements** in the array above as a vital cognitive challenge to oversimplistic closure on explanation as to their nature.

This exercise in mnemonic deconstruction might also suggest a degree of formal correspondence between 1 and 0 and **i** and **pi**, especially given the circularity of reasoning around a "hole" in the communication/comprehension geometry at the interface between knowledge and ignorance, as articulated in mathematical terms by Ron Atkin (as indicated above)

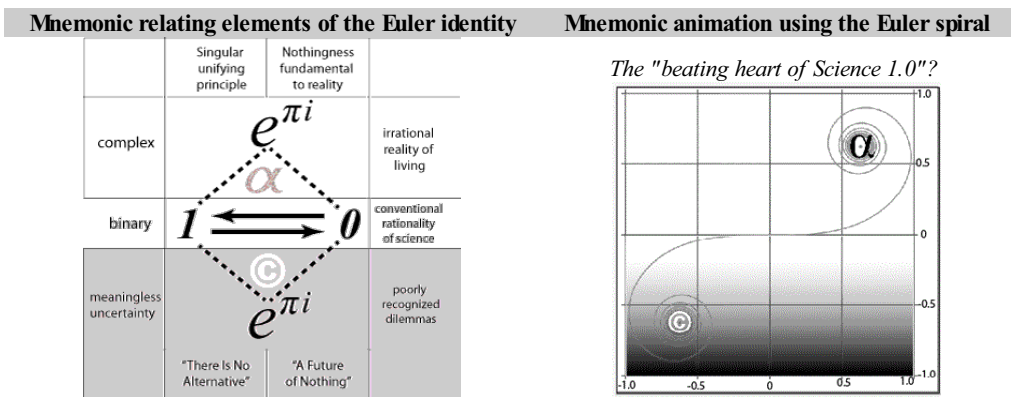
The cognitive challenges buried within science are highlighted separately (*Comprehension of ignorance, nonsense and craziness*. 2011). There it was noted that the disturbing implications of **Gödel's incompleteness theorems** regarding undecidability have now been reinforced by the work of **Harvey Friedman** (*Boolean Relation Theory and Incompleteness*. 2010) through identification of entirely new forms of incompleteness. In his summary of such challenges, Richard Elwes (*It doesn't add up*, *New Scientist*, 14 August 2010) asks whether "a gaping hole has opened up in the foundations of mathematics".

However, with respect to the above argument, perhaps even more challenging, is what this may imply for a "gaping hole" in the foundations of philosophical reflection on the development of consciousness and the governability of the planet. Curiously, as noted by Elwes:

With Friedman's work, it seems Gödel's delayed triumph has arrived: the final proof that if there is a universal grammar of numbers in which all facets of their behaviour can be expressed, it lies beyond our ken... The only way that Friedman's undecidable statements can be tamed, and the integrity of arithmetic restored, is to expand **Peano's rule book** to include "large cardinals" -- monstrous infinite quantities whose existence can only ever be assumed rather than logically deduced... We can deny the existence of infinity, a quantity that pervades modern mathematics, or we must resign ourselves to the idea that there are certain things about numbers we are destined never to know

**Mnemonic summaries?** The following provocative juxtaposition of the elements of the Euler identity offer mnemonic devices relating its implications to the following argument.

The **upper half** (left image) notably through the **e**-element, is indicative of the transcendental excellence with which that identity is associated in mathematics -- highlighting the value associated with both oneness and with nothingness, and the complex relation between them, experienced to a degree in the subtle complexities of living (*Living as an Imaginal Bridge between Worlds: global implications of "betwixt and between" and liminality*, 2011). Here the **i-element** is indicative of imagination, inspiration and intuition as they are most appreciated in life, with the **π-element** indicative of the coherence sought, symbolically associated with the circle. Appropriately provocative is the addition of **α** as an indication of the exclusive authority with which such understanding is articulated.



The **lower half** (left image) is indicative of the meaningless uncertainty of life as it is experienced by many -- confronted as they are by uncompromising political declarations to the effect that "There Is No Alternative" in a period in which the future is believed by many to have nothing to offer them. More provocatively the **e**-element is suggestive here of the evil to which Barack Obama referred in the course of his acceptance of the Nobel Peace prize: *For make no mistake: evil does exist in the world.* (*Remarks by the President at the Acceptance of the Nobel Peace Prize*, 10 December 2009). This is consistent with the current controversies regarding evil, variously considered to be embodied by the US, its critics, and its opponents.

Here the **i-element** is indicative of the problematic variants noted above, most notably incomprehension, inattention and the recourse to inebriation to engender imaginative engagement with coherence (indicated by the **π-element**) -- otherwise excluded from rational life as experienced. In a world which science endeavours to frame in exclusively rational terms, it is extraordinary the importance attached to inebriation and use of drugs -- notably by scientists -- in order to escape that reality.

In both upper and lower variants, the **e**-element is indicative of the complex nature of **cognitive engagement** with life as experienced. Corresponding to the attachment to authoritative truth, as arrogantly articulated by alpha-males in many cases (indicated by **α** in the upper half), is the addition of the **copyright symbol** © in the lower half -- as being indicative of the primary importance attached implicitly (if not explicitly) to exclusive possession of knowledge and its restrictive dissemination. It could be considered as the primary

symbol of the methodology of Science 1.0 -- far more widely recognized than the Euler identity, despite the acknowledged beauty of the latter. Mnemonically the  $e$ -element can be interpreted as a strange combination of engagement, exclusivity and experience.

The mnemonics may be taken further in that the conventional sequence of  $i$  and  $\pi$  is reversed in the Euler identity to offer an association to "epi", as separately explored (*Sensing Epiterrestrial Intelligence (SETI): embedding of "extraterrestrials" in episystemic dynamics?* 2013).

In the spirit of this tentative exploration, the **right hand image** makes use of the **Euler spiral**, a curve whose curvature changes linearly with its curve length, namely the curvature of the circular curve is equal to the reciprocal of the radius. This is potentially appropriate to this argument in that such spirals are widely used as transition curves for connecting and transiting the geometry between the linearity of a tangent and a circular curve (as is evident in railroad engineering and highway engineering). The horizontal portion is consistent with the linearity which dominates the binary thinking of Science 1.0, and its transition to the strange logic of the spiral extremes. The coordinates offer a useful play on the relationship between 0 and 1 highlighted in the left hand image.

Provocatively, the animation has the symbols of **alpha** and **omega** alternating at the centre of the upper spiral -- as an indication of the aspiration to omega as a culmination in the advancement of knowledge (Theory of Everything, etc). The **copyright** © and **registered trademark** ® symbols alternate at the centre of the lower spiral -- as an indication of the ambiguity of the seemingly primary preoccupations of science, especially in ranking of academic efficiency in terms of patents and business implications. The graded shading of the lower half (matching the shading of the left hand image) can be related to understandings of the "netherworld" of science, as explored more generally using the Euler spiral (*Designing Global Self-governance for the Future: patterns of dynamic integration of the netherworld*, 2010).

**Intellectual property: copyright, patents, and naming:** The focus on copyright by science, and the associated issue of attributing the names of "discoverers" to theories, particles, astronomical objects and species, could readily be considered as symptomatic of a psychological weakness of scientists obsessed with renown (IAU, *Naming Astronomical Objects*; IAU, *Buying Stars and Star Names*; IAU, *Public Naming of Planets and Planetary Satellites*). The IAU is the registering authority for such astronomical objects, just as there are analogous scientific bodies for the naming of plants, for animals, chemicals, and geographic features. At what stage should control of **nomenclature** be recognized as engendering a scientific **Nomenklatura**?

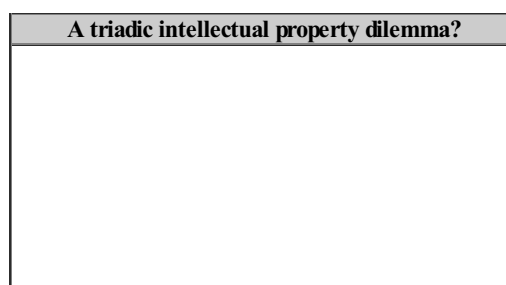
Should a particle proclaimed as a key to understanding the physics of the universe be named the "Higgs boson" for all eternity? Is modesty valued in any way in Science 1.0? How will extraterrestrials react to the naming of their places of origin? How will humanity react to the naming of its various cultures by them?

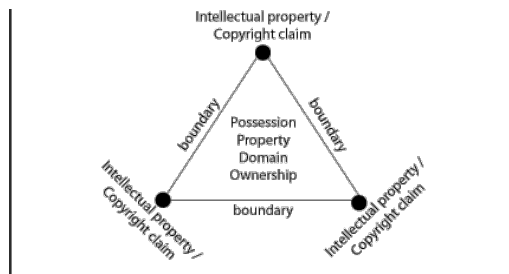
The issue is discussed separately in more general terms (*Identity, Possessive World-making and their Transformation Dynamics*, 2012), notably with respect to: *Identity framed by geometric forms*, *World-making and possession of property*, and *Forms of transformation: geometric vs. resonance*. With respect to naming, this notes:

The process of naming is of course a subtle means of establishing a claim to a degree of possession of an identity associated with a distant form. Clearly every identity is potentially free to name the features visible from its own worldview, without subscribing to those attributed by others. This recalls the process of psychosocial appropriation of a space at the collective level described by the process of *land nam*, coined by **Ananda Coomaraswamy** (*The Rg Veda as Land-Nama Book*, 1935), to refer to the Icelandic tradition of claiming ownership of uninhabited spaces through weaving together a metaphor of geography of place into a unique mythic story. This territorial appropriation process, notably practiced by the Navaho and the Vedic Aryans, was further described by **Joseph Campbell** (*The Inner Reaches of Outer Space: metaphor as myth and religion*, 2002):

*Land nam* ("land claiming or taking") was [the Norse] technical term for this way of sanctifying a region, converting it thereby into an at once psychologically and metaphysical Holy Land.... *Land nam*, mythologization, has been the universally practiced method to bring this intelligible kingdom to view in the mind's eye. The Promised Land, therefore, is any landscape recognized as mythologically transparent, and the method of acquisition of such territory is not by prosaic physical action, but poetically, by intelligence and the method of art; so that the human being should be dwelling in the two worlds simultaneously of the illuminated moon and the illuminating sun.

Such processes of naming and intellectual copyright then point to the challenge of coherent globality in which knowledge domains and modalities are arbitrarily "carved up", as has been the surface of the planet. Science 1.0 has done little to address the challenge and its practices inherited from the past reinforce existing dysfunctionality and the associated management of resources. Understood in terms of the triangulation, by which claims to a surface are established through relevant distinctions, the following representation calls for extensive rethinking. One possible approach may merit consideration (*Einstein's Implicit Theory of Relativity - of Cognitive Property? Unexamined influence of patenting procedures*, 2007).



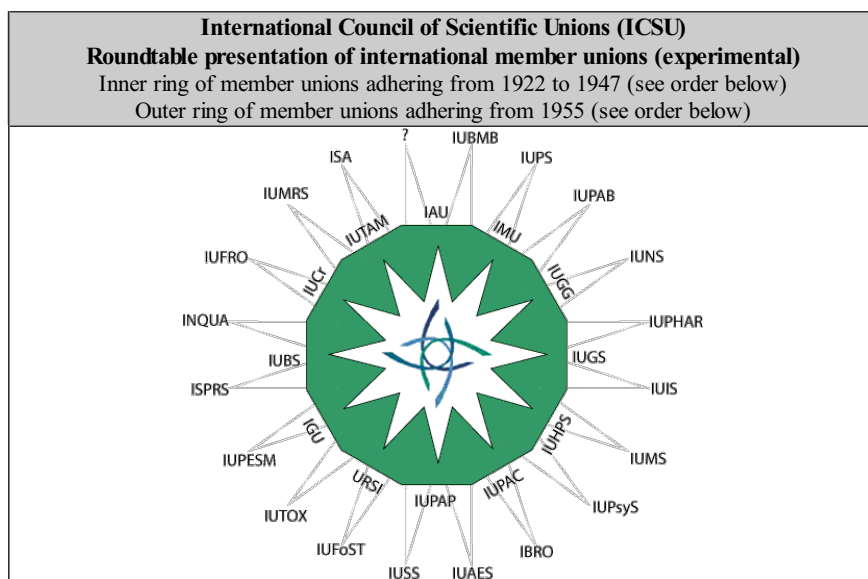


## Symbolic implications: ICSU as a case study

There is a case for exploring a more encompassing understanding of science through mythological traces -- most specifically the frequent academic use of "roundtable", so central to [Arthurian legend](#). This implies a sense of a future knowledge-based [Camelot](#) whose precursors may be evident to a degree in the recent emergence of a few "science cities" (for example: [Science City of Muñoz](#), Philippines; [Kansai Science City](#), Japan; [Science City Kolkata](#), India; [Guangzhou Science City](#), China; [Gujarat Science City](#), India; [Naukograd](#), Russia), as distinct from [technopoles](#).

Any such roundtable evokes a complex of associations in relation to the knights of yore seated around it -- and the ritual echoes still celebrated in the most eminent academic environments. This might include the cognitive armour they wear to protect them from intellectual threats, and the intellectual weapons they bear in the quest for truth. It could also include a recognition of the traditional [five steps to knighthood](#) (right background, upbringing, page, squire, then knight) with its echoes in modern scientific education.

As with the Arthurian roundtable, it remains mysterious as to what are the distinctive archetypal functions of the knights, the values they respectively uphold, or whether they themselves recognize the functions in cognitive and systemic terms. Beyond the narrow preoccupations of science, the matter can be variously explored (*Enabling a 12-fold Pattern of Systemic Dialogue for Governance*, 2011; *Eliciting a 12-fold Pattern of Generic Operational Insights*, 2011; *Checklist of 12-fold Principles, Plans, Symbols and Concepts: web resources*, 2011).



<b>International Council of Scientific Unions (ICSU)</b> (as distributed in the roundtable presentation above)					
*	International member unions (joined 1922-1947)	Member since	*	International member unions (joined after 1947)	Member since
1	IAU	1922	13	IUBMB	1955
			14	IUPS	1955
2	IMU	1922	15	IUPAB	1966
			16	IUNS	1968
3	IUGG	1922	17	IUPHAR	1972
			18	IUIS	1976
4	IUGS	1922	19	IUMS	1982
			20	IUPsyS	1982
5	IUHPS	1922	21	IBRO	1993
			22	IUAES	1993
6	IUPAC	1922	23	IUSS	1993
			24	IUFoST	1996
7	IUPAP	1922	25	IUTOX	1996
			26	IUPESM	1999
8	URSI	1922	27	ISPRS	2002
			28	INQUA	2005

9	IGU	<a href="#">International Geographical Union</a>	1923	29	IUFRO	<a href="#">International Union of Forest Research Organizations</a>	2005
				30	IUMRS	<a href="#">International Union of Materials Research Societies</a>	2005
10	IUBS	<a href="#">International Union of Biological Sciences</a>	1925	31	ISA	<a href="#">International Sociological Association</a>	2011
11	IUCr	<a href="#">International Union of Crystallography</a>	1947				
12	IUTAM	<a href="#">International Union of Theoretical and Applied Mechanics</a>	1947				

The experimental distribution of ICSU union members around the schematic "roundtable" above can be taken further by configuring them onto the faces (and vertices) of selected polyhedra as shown below.

<b>International member unions of ICSU mapped onto polyhedra</b> (arbitrary mapping location for illustrative purposes only) Images and animations developed using software developed by Robert Webb ( <a href="#">Stella: Polyhedron Navigator</a> ).	
<b>Dodecahedron</b> Initial 12 members onto pentagonal faces Later members onto vertices (rotation animation: 4MB)	<b>Icosidodecahedron</b> Initial 12 members onto pentagonal faces Later members onto triangular faces (rotation animation: 3MB)

The following images present the 3D polyhedra above in unfolded form as 2D polyhedral nets.

<b>International member unions of ICSU mapped onto polyhedral nets</b> (unfolded versions of above; arbitrary mapping location for illustrative purposes only)	
<b>Dodecahedral net</b> Initial 12 members onto pentagonal faces Later members onto vertices (not visible) (folding animation: 2MB)	<b>Icosidodecahedral net</b> Initial 12 members onto pentagonal faces Later members onto triangular faces (folding animation: 2.5MB)

Many reservations can be made regarding the experimental distribution. Consideration could be given to the possibility of fruitful juxtaposition of different unions -- perhaps exploiting other features of polyhedra. Distribution around a table, and "having a seat at the table" is of course of primary importance in many summit gatherings, notably the UN Security Council. Whether actually having a seat obscures the dynamics favouring senior members is another matter -- traditionally highlighted by the phrase being seated "below the salt". The unoccupied "seat" in the distributions of 31 bodies might well be considered to be that of the representative of ICSU -- whose presence would otherwise be only implied.

The arbitrary distinction between the initial and later members is of course highly questionable. It is primarily justified by the sense that it would be the earlier disciplines which best framed "science" as understood by ICSU. They can be understood as the "12 knights" of the ICSU roundtable. The later members could then be framed as "squires". Since the later members now have equal status, their allocation to secondary positions around the roundtable (or on the polyhedra) is necessarily questionable. This is a reason for exploring the use of even more complex polyhedra.

It is important to note that there are other international unions which have international scientific unions as members. Their existence and preoccupation is indicative of the challenging relations between the sciences as variously understood. Of interest in this respect are the [Council for International Organizations of Medical Sciences \(CIOMS\)](#) and the [International Social Science Council \(IssC\)](#). The first highlights the fact that the health focus is essentially absent from the ICSU cluster; the second highlights an alternative approach to the

social domain, only represented by the most recent member of ICSU, the [International Sociological Association \(ISA\)](#). This addition, as with other more recent adherents, is presumably indicative of evolving political pressures regarding the nature of "science".

With respect to the concern with the symbolism associated with each "knight" around the table, the intention was originally to exploit the logos of the various bodies as "heraldic devices" on the above images. Unfortunately very few have logos which are not based rather simplistically on their title acronyms. The inspiring exception is the logo of the International Mathematical Union which has carefully sought a design reflective of its preoccupation (see [Borromean Rings Logo of the International Mathematical Union](#)). Use was however made of the ICSU logo as an appropriate centerpiece of the roundtable schematic. Is the absence of appropriately symbolic logos suggestive of a certain lack of "nobility" in heraldic terms?

## Psychosocial coherence as a resonance hybrid?

The argument above has cited various approaches through which an integrative sense of encompassing coherence might be achieved -- potentially recognizing the problems and suffering otherwise readily lost in statistical and other presentations ([Implication of Personal Despair in Planetary Despair](#), 2010). Clearly there are multiple "zones of coherence", notably associated with international organizations and constituencies. It is their very multiplicity which is itself problematic in the case of wicked problems -- actively indifferent to the artificial boundaries between those zones.

It might have been assumed that the world wide web would have compensated for any such dysfunctional separation ([Spherical Configuration of Interlocking Roundtables: internet enhancement of global self-organization through patterns of dialogue](#), 1998). The contrary would however seem to be the case in that separation is being reinforced under the guise of global connectivity, exacerbated by increasing information overload and despite the earlier optimism ([Dynamically Gated Conceptual Communities: emergent patterns of isolation within knowledge society](#), 2004).

The brief exploration of ICSU above offers one indication of a poorly explored opportunity to use polyhedra as a means of providing a degree of coherence to what is otherwise typically represented by network diagrams with little strategic focus ([Polyhedral Empowerment of Networks through Symmetry: psycho-social implications for organization and global governance](#), 2008). That argument was associated with articulations of related possibilities ([Towards Polyhedral Global Governance: complexifying oversimplistic strategic metaphors](#), 2008; [Polyhedral Pattern Language: software facilitation of emergence, representation and transformation of psycho-social organization](#), 2008; [Configuring Global Governance Groups: experimental visualization of possible integrative relationships](#), 2008; [Configuring Global Governance Groups: experimental animations and video sequences](#), 2008).

**Integrating the complex of problems, strategies and disagreement:** Missing from current concerns with global governance, as noted with respect to simulations, is a fruitful integration of **problems** (as perceived by those claiming to be affected), **strategies** (advocated for their resolution by interested parties with diverse motivations), the **values or ends** upheld as desirable, and the many **theories** regarding the associated processes and possibilities. This lack is further exacerbated by the variety and level of **disagreement** between the **zones of coherence** of the many parties involved -- whether exceptionally informed and knowledgeable, or otherwise framed as variously misguided.

Having made a case for exploration of the value of polyhedra, there is a provocative possibility for clarifying the situation that merits a degree of consideration. This especially follows from the speculative remarks regarding the Euler identity and the role of the "imaginary unit" ( $i$ ) -- as a "fudge factor" through which cognitive processes that are intrinsically human are incorporated into the explanation of rational explanation of reality. More creatively  $i$  can be understood as intimately related to the process of human imagination in the so-called real world.

The following is inspired by what has been recognized in any shortlist of mathematically beautiful equations, namely the so-called "[Euler characteristic](#)" (in contrast with the "Euler identity" discussed above). This characteristic, commonly denoted by the Greek letter  $\chi$ , is a [topological invariant](#), a number that describes a [topological space's](#) shape or structure regardless of the way it is bent. It is a key feature of [algebraic topology](#) and [polyhedral combinatorics](#) (David S. Richeson, [Euler's Gem: the polyhedron formula and the birth of topology](#), 2012).

The Euler characteristic  $\chi$  was classically defined for the surfaces of polyhedra, according to the formula:

$$\chi = V - E + F$$

where  $V$ ,  $E$ , and  $F$  are respectively the numbers of vertices (corners), edges and faces in the given polyhedron. For example, any [convex polyhedron's](#) surface has Euler characteristic  $\chi = V - E + F = 2$ .

Despite the possibility of using polyhedra to clarify issues of governance, it would seem that there has been very little effort to explore the possible cognitive and psychosocial implications of that characteristic. One interesting exception is the work of [Rafael Nuñez](#), notably in collaboration with others ([George Lakoff](#) and Rafael Nuñez, [Where Mathematics Comes From: how the embodied mind brings mathematics into being](#), 2001; Rafael E. Nuñez, Laurie D. Edwards and Joao Filipe Matos, [Embodied Cognition as Grounding for Situatedness and Context in Mathematics Education](#)). Another is [Alison Pease](#), exploring computational creativity ([A Computational Model of Lakatos-style Reasoning](#), University of Edinburgh, 2007). It is in this sense that the following is consistent with the arguments of [Douglas Hofstadter](#) and Emmanuel Sander ([Surfaces and Essences: analogy as the fuel and fire of thinking](#), 2013).

To be clear, there is no question regarding the extensive efforts at [social network analysis](#) (if only by the intelligence services), rather it is a question of the sense of coherence with which particular forms of network may be cognitively associated -- partially as a consequence of their visualization as polyhedra.

**Triangulation of fundamental incommensurable concepts:** Understood at its most general, the issue is how the mind organizes the

three-fold and distinguishes its elements. In the case of topology, any surface can be divided up by a suitable configuration of edges, faces, and vertices. The fundamental nature of such three-fold division can be related to issues of governance, as separately argued (*Triangulation of Incommensurable Concepts for Global Configuration*, 2011). The latter has sections on: [Triadic logic?](#), [Triadic dialectics](#), [Triadic strategic applications](#), [Triadic conceptualization](#), and [Triadic education and learning](#).

One qualitative sense of the distinction is evident in the notions of [cardinality](#), [fixity](#), and [mutability](#) in astrology. A triadic clustering of concepts, notably in relation to political order, has been explored in some detail by [Paris Arnopoulos](#) (*Sociophysics: cosmos and chaos in nature and culture*, 2005). Triangulation is of course fundamental to the surveying and mapping of the topography of the Earth's surface. It is appropriate to ask whether an analogue merits attention in the case of knowledge space and mapping of the noosphere.

Following Arnopoulos, triads such as the following may be usefully distinguished with respect to science and governance:

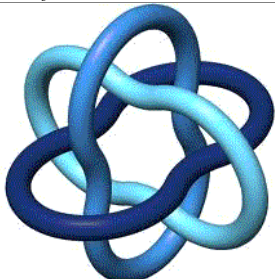
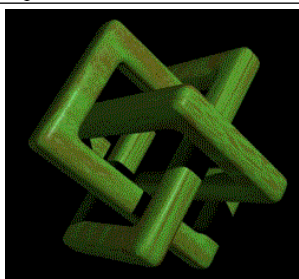
Examples of triads suggestive of a degree of mutual equivalence				
problem	question	strategic threat	assertion	principle
solution	answer/explanation	strategic response	agreement	clarification
discord	incompleteness	inadequacy	disagreement	incomprehension

Of interest here is whether a degree of fundamental generality may be found for each row, notably justifying the extent to which items in any row overlap or substitute for one another in different settings -- whether or not the columns lend themselves to fruitful qualitative distinction.

With respect to any recognition of 12 "functions" for purposes of governance (as noted above), there is a cognitive challenge to appropriately interrelating them, as discussed separately (*Imagining Attractive Global Governance: questioning possibilities and constraints of well-boundedness*, 2013). It is in this sense, as noted there, that a three-dimensional representation of that challenge is usefully recognized in various logos based on interlocked [Borromean rings](#). Most notable is the [logo of the International Mathematical Union](#) (mentioned above) -- one variant of that available for [interactive exploration](#) in *Wolfram Mathematica*. The 12 vertices of an [icosahedron](#) form five sets of three concentric, mutually orthogonal [golden rectangles](#), whose edges form such Borromean rings (*Towards Polyhedral Global Governance: complexifying oversimplistic strategic metaphors*, 2008). As concluded by Edward B. Burger and Michael P. Starbird (*The Heart of Mathematics: an invitation to effective thinking*, 2005, p. 381):

Three ideas -- the Golden Rectangle, the Platonic solids, and the Borromean rings -- all come together in the icosahedron; they exemplify the interconnectedness and beauty of our geometric universe.

Appropriate to the above argument, the topology of Borromean rings is now seen as a means of understanding [quantum entanglement](#) (Ayumu Sugita, *Borromean Entanglement Revisited*, 2007) -- and is recognized to be of potential relevance to future [topological quantum computing](#).

Variants of Borromean rings in 3-dimensions	
<p><b>Logo of International Mathematical Union</b> (see <a href="#">Wolfram Mathematica animation</a>)</p> 	<p><b>Rectangles linked as Borromean rings</b> (<a href="#">image</a> reproduced from <i>Wikimedia Commons</i>)</p> 

Such images point to the nature of the challenge of interrelating the three Abrahamic religions, so fundamental to issues of global governance and the conflicts undermining its possibilities. A notable pointer is an early [Borromean-ring configuration of the Christian Trinity](#) together with related forms ([Triskelion](#), [Triquetra](#)). Also known as "Borromean rings", the Triquetra (or [Tripod of Life](#)) is formed from a third circle added to the [Vesica Piscis](#), together related to the [Flower of Life](#) (valued in Judaism and Islam). Islam is noted for the remarkable richness of symbolic patterning in two dimensions -- including [Solomon's Knot](#). Whether representation of Borromean rings in three dimensions offers an unsuspected key to more fruitful relationships between those belief systems remains to be discovered (Peter R. Cromwell, *The Search for Quasi-Periodicity in Islamic 5-fold Ornament*).

The subtlety of the argument, and the obvious challenge of the logo, suggests that any self-reflexive science -- beyond Science 1.0 -- would examine more attentively the seemingly simplistic "binary" relations within the complexes of "problem/solution/disagreement", "question/answer/inadequacy", and the like. Clearly the same applies to challenges of global governance. The entanglement within any such triadic complex is especially highlighted by the sense in which their constituent concepts are mutually orthogonal in three dimensions -- namely of radically different orientation.

**Interweaving metaphors through "metaphorical morphing":** The question might then be framed as how various understandings of "problem", "resolution" and "disagreement" might be fruitfully related to any polyhedral representation in terms of "vertex", "face" and "edge" -- in the light of metaphorical insights into both groups. This would enable each to be explored far more generically in cognitive

terms -- especially given the hydra-like nature with which the associated challenges and opportunities are encountered.

It is appropriate to note that a polyhedron can be understood as a "container" -- extensively explored as the "container metaphor", initially by George Lakoff and Mark Johnson (*Metaphors We Live By*, 1980). This suggests that the following merit exploration as metaphors:

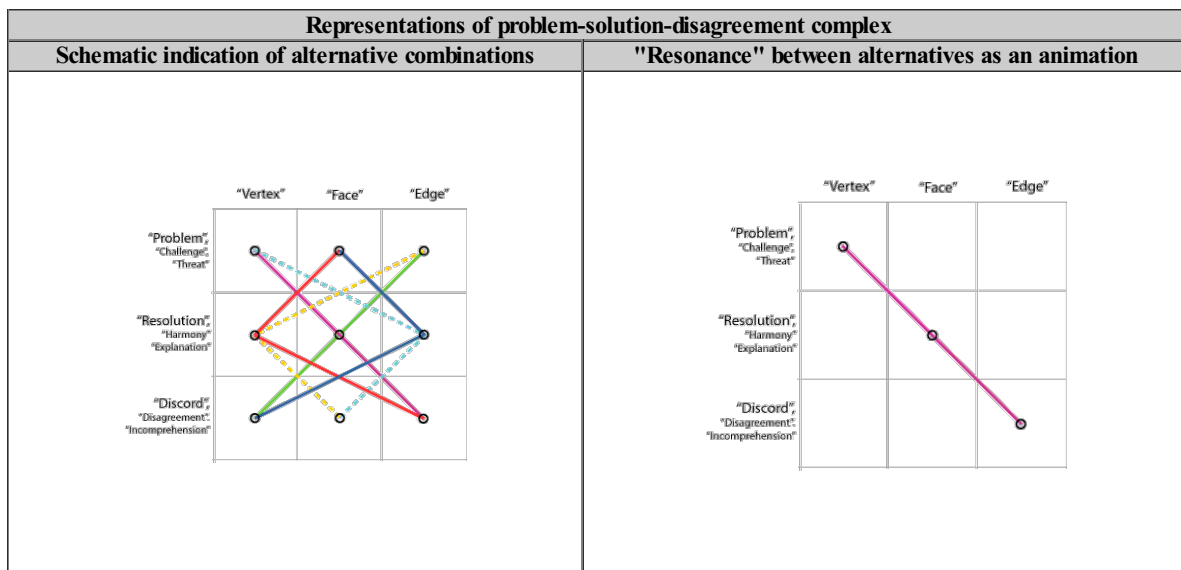
- **"problem"**, however this may be experienced -- **dynamically**, rather than statically -- as a **challenge**, a **threat**, or provocative **assertion** -- or possibly as a **question**. Represented by:
  - *a vertex*: Recognizable through the stress on "peak" problems (*Checklist of Peak Experiences Challenging Humanity*, 2008) and issues "coming to a peak"
  - *a face*: Partly recognizable in "facing up to a problem" and "in the face of things", as well as issues "in your face". Also a sense of a chaotic arena of problems.
  - *a edge*: Recognizable in understanding of problematic boundary conditions, "stepping over the line", "red line", and "going over the edge". Possibly as a problematic bond.
- **"resolution"**, however this may be experienced -- **dynamically**, rather than statically -- as a shared **agreement**, **reconciliation**, or (unexamined) **assumption** -- or possibly as an **answer**, a strategic **response**, or an **explanation**. Represented by:
  - *a vertex*: Partly recognizable through an overview perspective, an advantageous strategic "high point", and also as highly valued "peak experiences". Possibly as some form of confluence
  - *a face*: Recognizable through the expression "putting a good face on things", as characteristic of promotional presentations of strategic initiatives. Related to the planar implications of explanation. Also as a domain of agreement and commonality -- of similar orientation.
  - *a edge*: Recognizable in terms of "leading edge" and "cutting edge". Possibly as a bond of mutuality or approval
- **"disagreement"**, however this may be experienced -- **dynamically**, rather than statically -- as inadequacy, incommensurable, irreconcilable, incomprehensible, or incompleteness. . Represented by:
  - *a vertex*: Recognizable through conflict and disagreement "coming to a peak" in a nexus of disagreement .
  - *a face*: Recognizable as a zone of discord, conflict or incomprehension
  - *a edge*: Recognizable as a bond of discord, or disapproval

Given the argument for topology, and the relative value of topography, a case can be made for putting the *topos* -- as an experiential **sense of place** -- back into topology

The possible comprehension of a cognitive **problem-solution-disagreement complex** can then be variously represented in six generic modes -- each of which frames the complex in a distinct manner according to the cognitive implication of its representation as vertex (V), face (F) and edge (E).

	6 contrasting modalities of representation					
"Problem"	V	V	F	F	E	E
"(Re)solution"	F	E	V	E	F	V
"Discord"	E	F	E	V	V	F

The interpretation of the **problem-solution-disagreement complex** in terms of any of the 6 cognitive modalities identified above is further indication of the slippery fluidity through which such a complex may be understood in any debate. The complex might well be understood dynamically as the pattern of alternation between such modalities -- namely a form of **resonance** -- much as in the case of the **benzene molecule** as the **resonance hybrid** so fundamental to organic life. The nature of the "hydra" is such that it is misleading to frame it as "this" or "that" when it readily transforms from one form to another form. The Euler characteristic offers insight into its invariance whatever form it appears to take. This is indicated with the aid of the following schematics.



Related images and animations of relevance to global governance are explored separately (*Predictability and pattern-breaking: the Knight's move*, 2011; *Reframing "monkeying" in terms of Knight's move patterns*, 2011; *Insights from Knight's move thinking*, 2012).






As noted below, the switch in metaphorical interpretation of whatever is associated with a polyhedral "face" or "vertex" is especially significant to any engagement with the hydra -- whether in science or governance. Most specifically:

- a solution or agreement, associated with a "face", can be challenged as itself constituting or implying a problem, represented by a "vertex"
- common focus on a problem, associated with a "vertex", can be recognized as itself constituting or implying a solution, represented by a "face"





This is especially evident in the case of the [transformation of a polyhedron into its dual](#), namely face-to-vertex and vertex-to-face, as illustrated below. This constitutes a more readily comprehensible form of a relationship in which [duality in higher dimensions](#) may be of potentially greater significance.

## Polyhedral containers for metaphorical morphing complexes

In this light a **problem-solution-disagreement complex** might be configured in a variety of polyhedral forms, as indicated by the following tables of examples from *Wikipedia* -- but understood as [complex dynamical systems](#), notably as stressed by [R. Buckminster Fuller](#) (*Synergetics: Explorations in the Geometry of Thinking*, 1975), and separately discussed (*Geometry of Thinking for Sustainable Global Governance: cognitive implication of synergetics*, 2011).

Euler characteristics of polyhedra					
Spherical polyhedra having a common Euler characteristic			Nonconvex polyhedra having various Euler characteristics		
(adapted from <i>Wikipedia</i> )			(adapted from <i>Wikipedia</i> )		
Name	Image	V	E	F	Euler $\chi$ $V - E + F$
Tetrahedron		4	6	4	2
Hexahedron or cube		8	12	6	2
Octahedron		6	12	8	2
Dodecahedron		20	30	12	2
Icosahedron		12	30	20	2

Name	Image	V	E	F	Euler $\chi$ $V - E + F$
Tetrahemihexahedron		6	12	7	1
Octahemioctahedron		12	24	12	0
Cubohemioctahedron		12	24	10	-2
Great icosahedron		12	30	20	2

As indicated above, comprehension in practice of any **problem-solution-disagreement complex** bears comparison to engagement with a hydra or with any other form in continuous morphological transformation (as myth and fantasy have explored). This is consistent with the [extensive literature on wicked problems](#), separately discussed in the main paper in terms of *Wicked problems and the renunciation of science*.

There is increasing sensitivity to the ineffectual nature of what is conventionally upheld as meaningful social, political or scientific discourse in response to problems -- especially those of a wicked nature. This has been well-framed in commentary on the climate change debate:

*I have the sense of walking into a barroom brawl* (Steven T. Corneliusen, *Climate wars continue in the New York Review of Books, Physics Today*, 18 April 2012).

In a variety of domains calls are specifically made for "profound dialogue". Claims made for "profundity of dialogue" may however be used in practice to reframe a "process" in which "nothing" is achieved -- as is characteristic of interfaith dialogue. As in cosmology, that "nothing" may well call for deeper understanding (*Emerging Significance of Nothing*, 2012; *Epistemological Panic in the face of Nonduality: does nothing matter*, 2010; *Import of Nothingness and Emptiness through Happening and Mattering*, 2008).






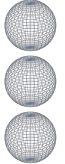






If any such debate, or emergent understanding, is recognized cognitively as associated with a surface or form -- potentially described in topological terms -- then the value of the Euler characteristic becomes increasingly apparent. Reference is, for example, occasionally made to the "shape" of a discussion or debate -- and even with comments prefaced by "on the surface" with regard to their appearance. Where a hydra may take many forms, the Euler characteristic (or Euler number) is indicative of topological invariance.

**Beyond aspirations to oversimplistic coherence:** The conventional aspiration to coherence, unity and oneness in psychosocial situations is typically associated with a sphere and the sense of globality. In such cases the Euler characteristic is 2, as with the spherically symmetrical convex polyhedra -- usefully recognized as progressive approximations to a sphere, according to the increasing number of faces. An obvious difficulty in practice is that reducing the number of faces -- to the point at which coherence is framed as a tetrahedron (pyramid) -- constitutes a far more challenging reconciliation of contiguous faces (of radically different orientation) than one in which the faces are more numerous, as with the dodecahedron (for example), or more complex forms.

The potential of this approach becomes even more interesting with recognition of the very extensive exploration and generalization of the Euler characteristic in algebraic topology. Expressed otherwise, it could be said that there are extensive resources for "coming to grips" more effectively with the hydra-like dynamics of wicked **problem-solution-disagreement complexes**. A rich language and notation has

been developed to encompass "multidimensional hydra".

Missing from those preoccupations to date has been any explicit association of them with the psychosocial dimension in its cognitive experiential sense. Many of the arguments of psychoanalysts, such as [R. D. Laing](#) and [Jacques Lacan](#), are however highly suggestive in this respect, notably in the light of their specific topological interest in [knot theory](#). It is of course precisely such potential associations that are explicitly deprecated by scientists such as [Alan Sokal](#) and [Jean Bricmont](#) (*Fashionable Nonsense: postmodern intellectuals' abuse of science*, 1999), who have contributed so little to reframing remedies to the challenges of humanity

Implications of Euler characteristic for interpretation of coherence			
Examples of Euler characteristic of various surfaces calculated by their polygonization (adapted from <i>Wikipedia</i> )			Commentary on implications for interpretation of coherence according to contrasting framings
Name	Image	Euler characteristic	
Interval		1	coherence associated symbolically with a bond -- a "special relationship" (disagreement or problem)
Circle		0	coherence associated symbolically with a circle -- a widespread indication of unity and of combat arenas
Disk		1	coherence associated symbolically with a disk -- with its widespread solar implications
Sphere		2	coherence associated symbolically with a sphere -- widely used as an indication of unity and "sphere of influence"
Two spheres (not connected) (Disjoint union of two spheres)		$2 + 2 = 4$	coherence associated symbolically with two separate spheres -- as with political, religious, disciplinary, or economic domains
Three spheres (not connected) (Disjoint union of three spheres)		$2 + 2 + 2 = 6$	coherence associated symbolically with three separate spheres -- as with political, religious, disciplinary, or economic domains
Double torus		-2	coherence associated symbolically with linked tori -- readily associated with "marriage" of any form
Triple torus		-4	coherence associated symbolically with a triple torus -- readily associated with nuclear "family"
Real projective plane		1	coherence associated symbolically with a symmetrical complex ?
Torus (Product of two circles)		0	coherence associated symbolically with a torus -- as used with in ritual jewelry, crime rings, web rings, and the <i>Fellowship of the Ring</i>
Möbius strip		0	coherence associated symbolically with a Möbius strip (cf. Steven Rosen, Science, Paradox and the Moebius Principle; Douglas Hofstadter, <i>I Am a Strange Loop</i> )
Klein bottle		0	coherence associated symbolically with a Klein bottle (cf. Steven M. Rosen, <i>Topologies of the Flesh</i> )

It should be stressed that algebraic topology is able to explore forms of far greater complexity -- presumably beyond the possibility of their meaningful communication, even though the nature of some may be intuited. What psychosocial significance might higher orders of generalization indeed carry?

The clarification of the question may be taken further through consideration of the formal [classification of surfaces](#) (see [Math Surfaces Gallery](#) (and Java Applet for live rotation viewing). Of greater relevance to this argument is the work of [Michael Burt](#) ([Periodic Table of the Polyhedral Universe](#), *International Journal of Space Structures*, 2011; and [video presentation](#)). However, with respect to psychosocial interpretation of the shifting cognitive significance, there is a case for a table which extends that above in terms of the Euler characteristic

Contrasting modalities of representation on polyhedra requiring distinctive cognitive interpretation							
	Polyhedra and surfaces (indicative)	6 contrasting modalities of representation requiring distinctive cognitive interpretation					
Problem (or question, challenge, assertion)		V	V	F	F	E	E
(Re)solution (or consensus, assumption, commonality)		F	E	V	E	F	V
Disagreement (or inadequacy, incommensurability, incompleteness, or incomprehensibility)		E	F	E	V	V	F
...?							
Euler $\chi = -4$	triple torus						
Euler $\chi = -3$							
Euler $\chi = -2$	double torus						
Euler $\chi = -1$							
Euler $\chi = 0$	circle, torus, Möbius strip, Klein bottle						
Euler $\chi = 1$	disk, interval						
Euler $\chi = 2$	sphere, spherical symmetrical convex polyhedra						
Euler $\chi = 3$							
Euler $\chi = 4$	two disjoint spheres						
...?							

Of particular interest in the tables above is the contrast between those with a positive Euler characteristic and a negative one. The latter (given their concavity) might imply forms characterized by a higher degree of introspection and subjectivity (if not "depression"), in contrast to the objective explanation ("expression") more feasible in the former case (given their convexity).

**Implications for coherence with  $\chi = 0$ :** Especially intriguing are those with an Euler characteristic of 0 (circle, torus, Möbius strip, and Klein bottle). Given arguments to that effect, notably the work of [Steven Rosen](#), these are suggestive of a degree of self-reflexivity (*Towards Conscientific Research and Development*, 2002; *Sustaining a Community of Strange Loops: comprehension and engagement through aesthetic ring transformation*, 2010; *Enabling Wisdom Dynamically within Intertwined Tori: requisite resonance in global knowledge architecture*, 2012).

These may prove indicative of the possibility of a Science 2.0 within which "conscience" is intimately integrated, as separately argued (*Towards Conscientific Research and Development*, 2002).

## Global conversation and the nature of any emergent consensus

Conversation may be understood as global from two quite distinct perspectives. The most common is that associated with the spherical form of the planet and widespread concern with globalization processes and global communication around the globe. The second is indicative of a degree of integration and coherence, of which the first may be held to be symptomatic. The distinction is far greater with respect to the forms of integration of knowledge potentially a preoccupation of metascience. The distinctions are discussed separately in terms of the implications for ever more meaningful dialogue (*Future Generation through Global Conversation: in quest of collective well-being through conversation in the present moment*, 1997).

It is perhaps indicative to note that, although David S. Richeson frames his study with the title *Euler's Gem* (2012), it seemingly contains no reference to [gemstones](#) whose [faceting](#) is so intimately related to the Euler characteristic -- given that the facets are the faces of a polyhedron exposed by cutting a precious stone. The purpose of cutting is to maximize the ability of the stone to gather and focus light through a combination of reflection and refraction -- itself meriting consideration with respect to arguments for the "circulation of light" (*Circulation of the Light: essential metaphor of global sustainability?* 2010). Of some relevance to the argument is the fact that stones are faceted into polyhedral forms which are not spherically symmetrical -- in order to capture and focus the light most effectively.

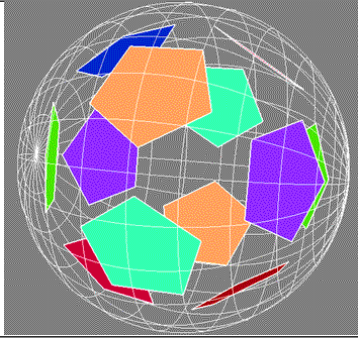
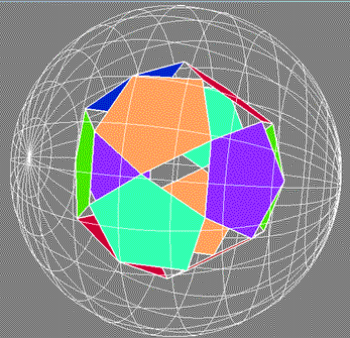
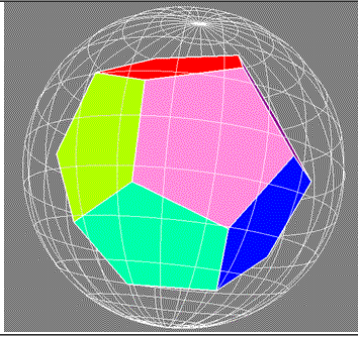
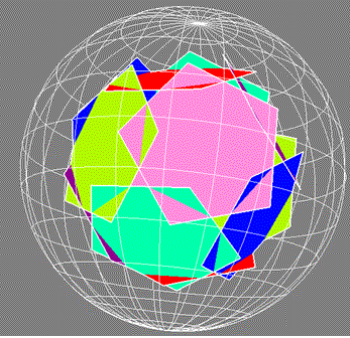
Given the value associated with gemstones, there is much to be said about their metaphorical significance with respect to the focusing of light through the forms considered above, as separately argued (*Patterning Archetypal Templates of Emergent Order: implications of diamond faceting for enlightening dialogue*, 2002; *Summary of Gemstone Faceting and Crystals*, 2002). The dissociation by Richeson is indicative of the challenge for any metascience to integrate human value and appreciation into what may otherwise only be appreciated as

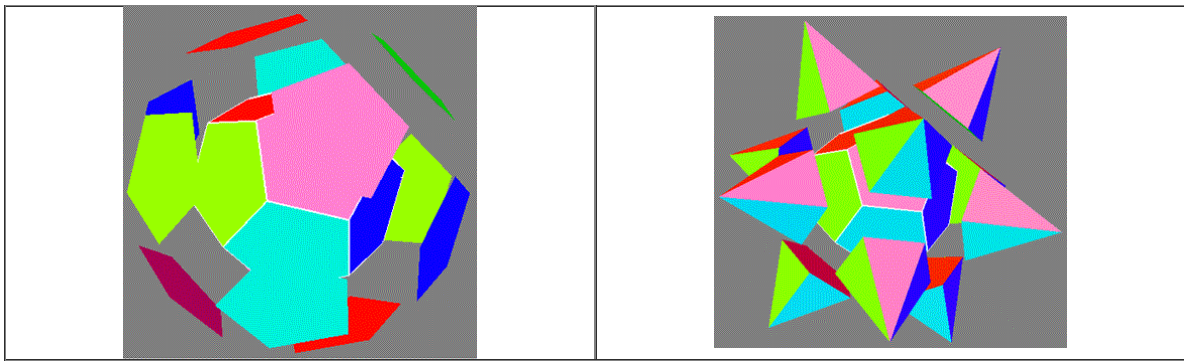
a beautiful "gem" in purely formal mathematical terms.

The argument can be taken further in the imaginative spirit of the discussion of the imaginary unit embodied in the Euler identity (as explored above). Of interest is how the problem-solution-disagreement complex can be imaginatively generalized in relation to psychosocial concerns:

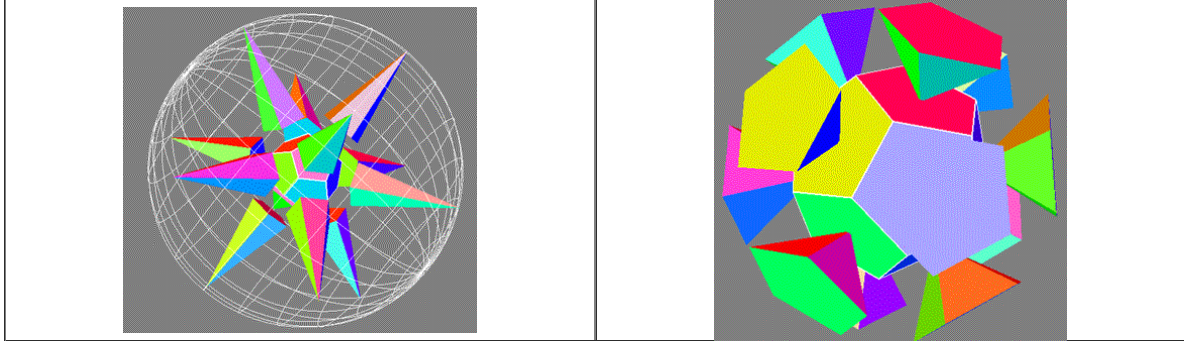
- It is tempting to reframe this as a question-answer-inadequacy complex in which the "bridging interface function" at the boundaries between the facial zones of any polyhedron is in some essential way associated with the array of intangible descriptors attributed to the imaginary unit (above).
- Any face can be usefully understood as an "arena" of conversation, even a roundtable, at which the perspective from each edge (implying that of another face, possibly extended to constitute a "seat-back" for the discussant), may be represented "in turn" in the "face-to-face" discourse process. This suggests, for example:
  - a tetrahedron as indicative of 4 distinct 3-fold conversations
  - a cube as indicative of 6 distinct 4-fold conversations
  - an octahedron as indicative of 8 distinct 3-fold conversations
  - a dodecahedron as indicative of 12 distinct 5-fold conversations
  - an icosahedron as indicative of 20 distinct 3-fold conversations
- Ron Atkin provides a remarkable mathematical analysis of any committee process (applied to his university), to be associated with a multi-sided face -- in which the conversation circles (without effective resolution) around the virtual centre of the face, as discussed separately (*Social organization determined by incommunicability of insights*). His argument is presented in terms of the comprehension of the perspectives represented by all the nodes of a triangle, rather than of any one of them, or any pair. By what polyhedra might various controversial debates be represented (climate change, etc)?
- The shifting pattern of requisite interpretation of the problem-solution-disagreement complex lends itself to striking illustration through the geometry of duals and the process by which a polyhedron may be morphed (transformed) into a related form. Especially evident, for example, is the manner in which a facial arena, interpreted as a space of commonality and consensus, may be "re-recognized" as a problem in its own right through transformation from a face into a vertex.
- The geometry of spherically symmetrical polyhedra implies the existence of:
  - a **circumsphere** passing through all the vertices, implying a degree of integrity to which the psychosocial dynamics associated with the polyhedron may only approximate -- or aspire
  - a **midsphere** touching the midpoints of the edges is indicative of what might possibly be framed as the lowest common denominator of the condition indicated by that polyhedron -- possibly on "what it is agreed to disagree"
  - an **insphere** tangential to each of the faces is indicative of what might possibly be framed as the highest common multiple of the condition indicated by that polyhedron -- namely some form of minimal agreement.

Some of these can be suggestively illustrated in the images below.

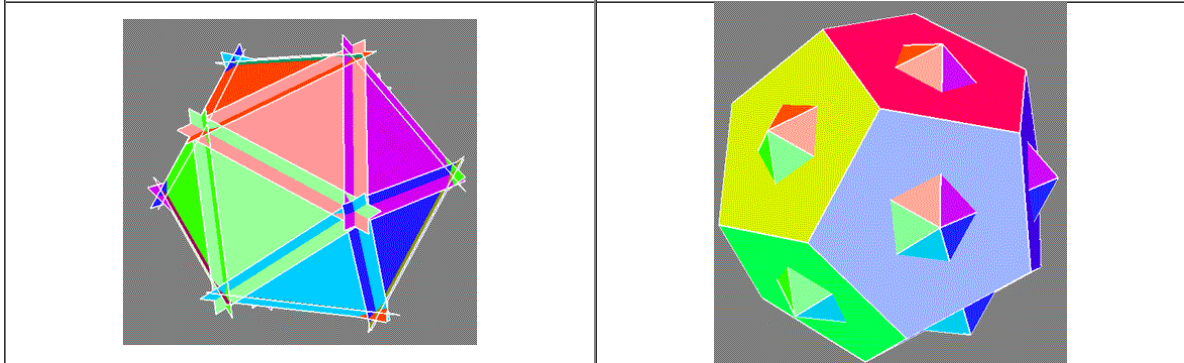
<b>Screenshots from manipulation of dodecahedron inviting suggestive interpretation according to each of the 6 modalities</b> (prepared using <i>Stella: Polyhedron Navigator</i> ).	
12 Disconnected 5-fold discussion arenas, configured within an implicit consensual sphere	12 Minimally connected 5-fold discussion arenas, configured within an implicit consensual sphere
	
12 5-fold discussion arenas configured contiguously	12 5-fold discussion arenas, implying a degree of mutual interference
	
Configuration of 12 5-fold discussion arenas, each engendering a potential plane of consensus	Configuration of 12 5-fold discussion arenas, each engendering a peak of agreement



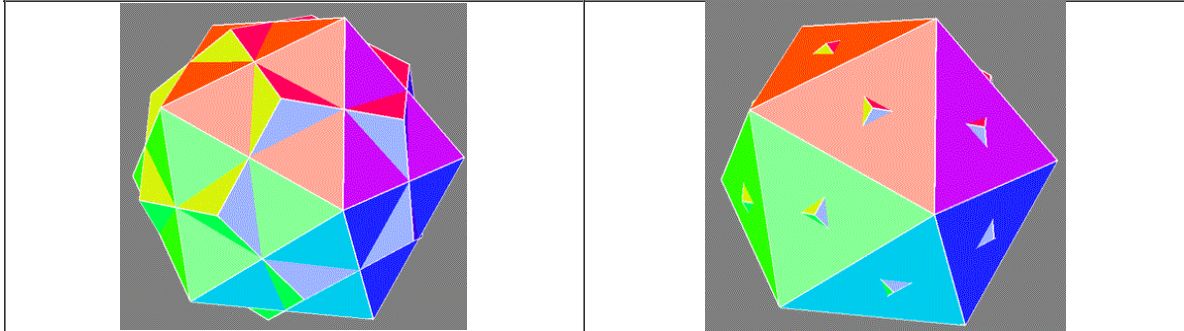
Configuration of 12 5-fold discussion arenas, with peaks linked by consensual cumsphere



12 5-fold discussion arenas, implying a degree of mutual interference



12 5-fold discussion arenas, with emergence of (challenging) dual (stage 2) midway between dodeca and icosia



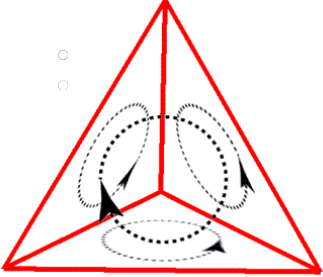
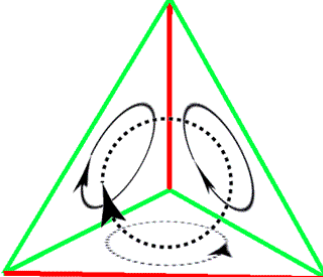
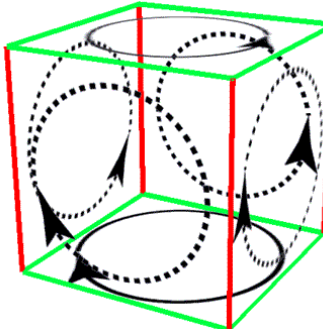
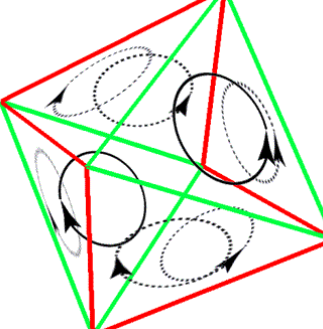
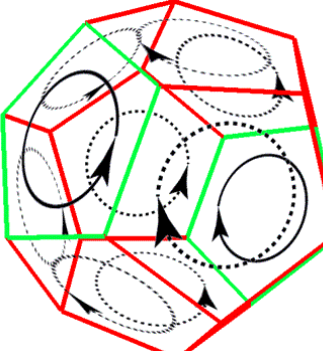
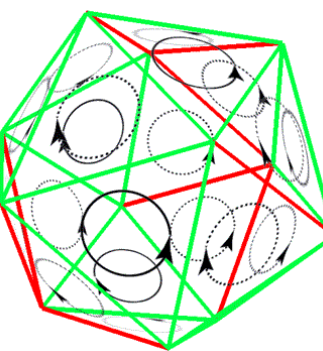
12 5-fold discussion arenas, with emergence of (challenging) dual (stage 3) icosia displacing dodeca

## Emergence of global coherence through Science 2.0?

The argument of the previous section regarding an emergent sense of globality may be taken further by considering a directionality to the conversation "around" the space indicated by any polyhedral face. This is partially suggested by the work on q-analysis of Ron Atkin (*Combinatorial Connectivities in Social Systems; an application of simplicial complex structures to the study of large organizations*, 1977) as separately summarized (*Social organization determined by incommunicability of insights*). This is partly recognized by the sense in which each representative in any dialogue arena is encouraged to contribute "in turn".

It could be said that the sense of globality is only possible when the existence of other faces of different orientation is recognized. This contrasts with a typical assumption in which the preferred dialogue arena is understood as uniquely appropriate -- as with a "Flat Earth" mentality, as separately discussed (*Irresponsible Dependence on a Flat Earth Mentality -- in response to global governance challenges*, 2008). Other faces are then deprecated as dangerously inappropriate -- over the edge -- "where dragons dwell".

The following images indicate the challenges of reconciliation between different dialogue domains (as "faces"). The point is made in the first two images using four domains configured as a tetrahedron. Clearly there is a conflict of directionality at each edge -- as illustrated by the left hand image -- when all conversations have the same directionality. The right hand image shows the effect of introducing conversations with reverse directionality. The image is coloured to distinguish between cases of matching directions (green) and mismatching directions (red). The approach is applied in the later images of conversations using the other Platonic polyhedra. Matching across an edge can be understood in terms of cooperation or collaboration, in contrast to conflict.

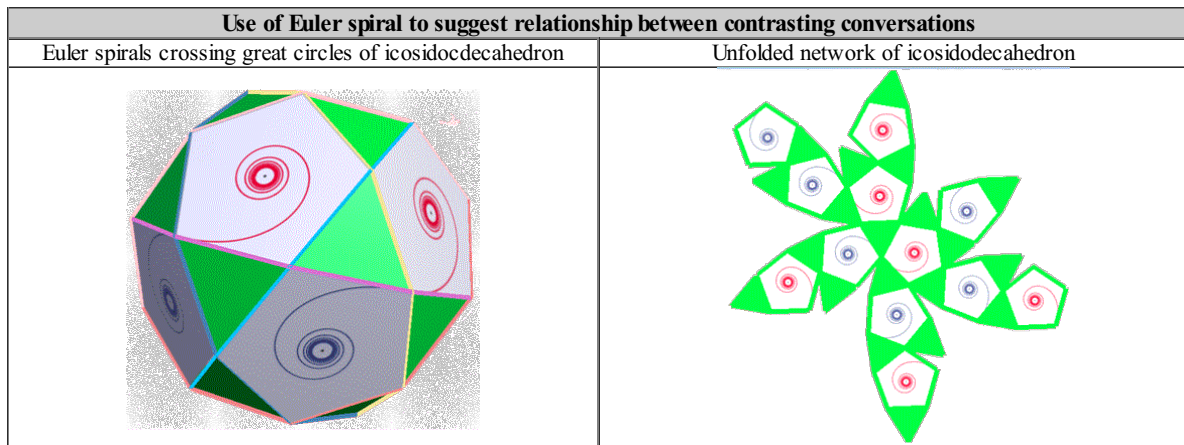
Screenshots indicative of "cooperative" possibilities in global configurations of conversations (prepared using <i>Stella: Polyhedron Navigator</i> from interactive animations -- necessarily far more meaningful)	
<p><b>Tetrahedron</b> showing mismatch of circle directionality between contiguous faces</p> 	<p><b>Tetrahedron</b> showing match (and mismatch) of circle directionality between contiguous faces</p> 
<p><b>Cube</b> showing match (and mismatch) of circle directionality between contiguous faces</p> 	<p><b>Octahedron</b> showing match (and mismatch) of circle directionality between contiguous faces</p> 
<p><b>Dodecahedron</b> showing match (and mismatch) of circle directionality between contiguous faces</p> 	<p><b>Icosahedron</b> showing match (and mismatch) of circle directionality between contiguous faces</p> 

Of particular relevance is clearly how "directionality" is to be understood in a global configuration. It may be as obscure to the comprehension in psychosocial situations as the metaphorical use of "spin" used to describe a fundamental property of elementary particles, or its use as a [spin tensor](#) describing spinning motion in special relativity and general relativity. Far more readily comprehensible are the opposing senses of spin of cyclones and anticyclones characterized globally by meteorology:

- **cyclone**: inward spiraling winds that rotate anti-clockwise in the northern hemisphere and clockwise in the southern hemisphere of the Earth, typically centered on areas of low atmospheric pressure
- **anticyclone**: characterized by clockwise rotation in the northern hemisphere, and counterclockwise in the southern hemisphere, centered on a region of high atmospheric pressure

Metaphorical use of "spin" can also be fruitfully related to conversations framed as "upbeat" or "downbeat", notably in the concern to appear "positive / optimistic / uncritical" rather than "negative / pessimistic / critical", at least for public relations purposes (*Being Positive Avoiding Negativity: management challenge of positive vs negative*, 2005). For an individual, in the language of bipolarity, the two might also be contrasted metaphorically in terms of manic and depressive respectively. There is also a sense that any "movement of opinion" may imply a circling motion -- rotating "to the left", or "to the right", in political terms. Related experimental animations, with directionality of arrows on faces of polyhedra, have been presented separately (*Arranging the flowers to engender an ecosystem?* 2014).

Reflection on such possibilities can be taken further by employing the transitional implications of the Euler spiral to relate mutually contrary cyclonic movement of opinion on neighbouring faces (as suggested by the following). Account can be taken of the [great circles](#) around a polyhedron in mapping Euler spirals across each great circle as shown in the image on the left below. The distinctively coloured circles provide a suggestive analogue to the Earth's equator with respect to directionality of cyclonic movement in its separate hemispheres. Of interest is how best to "fit" the spiral elements for greatest significance, together with the fact that the "linear" portion of each spiral is mapped along a portion of a great circle.



The images are merely suggestive of an approach to exploring the globality through which cognitive modalities can be interrelated. Other attributions of the Euler spiral could be considered: perhaps between triangular faces, rather than between pentagonal faces. Using the dodecahedron, a spiral could be positioned between contiguous pentagonal faces. Positioning spirals on both triangular and pentagonal faces would highlight the significance of the vertex where the linear portion of two spirals intersect.

The images above suggest that for a global configuration to be viable, a particular mix of conversational directionalities is required. The meteorological analogue is indicative of the fluid complexity of the mix of which the polyhedral forms are idealizations. More intriguing, in the light of the argument above for an understanding in terms of resonance, is the possibility that conversations in a configuration may need to alternate in direction -- thereby ensuring the coherence of the whole in cybernetic terms. Such alternation recalls the arguments of [Edward de Bono](#) for changing modalities according to six "hats" (*Six Thinking Hats*, 1985; *Six Frames for Thinking about Information*, 2008).

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